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CANADIAN

# ELECTRICAL NEWS

AND

# Engineering Journal

VOL. X - XI

106872
21.12.10

1900:
THE C. H. MORTIMER PUBLISHING COMPANY, OF TORONTO, LIMITED,
TORONTO, CANADA.

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CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. FEBRUARY, 1900 No. 2.

# The Incandescent Electric Light

## DATA SHOWING ITS ORIGINAL DISCOVERY IN TORONTO, CANADA.—DR. WOODWARD'S PATENT ANTE-DATES THE PATENT OF MR. T. A. EDISON, AND IS PURCHASED BY THE AMERICAN INVENTOR.

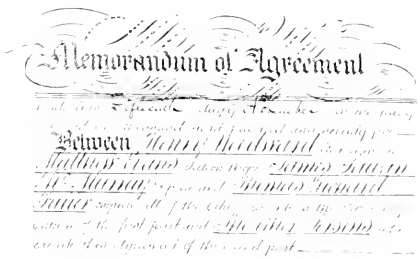
Some interesting historical data has recently been placed at our disposal and is herewith presented to readers of THE ELECTRICAL NEWS, relative to the original discovery of the principle of the electric light. It will interest our readers to learn that this discovery appears to have been made in Toronto, Canada, and patented in Canada and the United States prior to the time when a patent was granted to Mr. T. A. Edison. It is quite as interesting to know that the patent for the Canadian discovery was purchased by Mr. Edison in New York City at the time when he was making his original investigations and before he obtained his patent.

To Henry Woodward, a medical student, and Matthew Evans, a hotel keeper, of Toronto, Ont., appears to be due the credit for the first discovery of the principle of the incandescent electric light. They were neighbors and frequently experimented together with a large Smead battery and induction coil, of which Woodward was the possessor.

While seated at dusk one evening watching the buzzer of the induction coil, the light of the spark at the contact post drew their attention. Evans was the first to notice it, and drawing out his watch exclaimed, "Look at the light from that spark! Why you can see the time!" "My!" said Woodward, "if one could only confine that in a globe of some sort, what an invention we would have! It would revolutionize the world!"

DR. WOODWARD'S PIONEER ARC LAMP.

From this beginning, in the early part of 1873, Woodward and Evans worked to perfect the idea, and on August 3rd, 1874, were granted a Canadian patent. The method of exploiting the discovery is set forth in the accompanying agreement by the original promoters :




"Whereas the said Henry Woodward having invented a new and improved method of obtaining light by means of electricity, and having received advances and other assistance from the said other parties hereto of the first part, agreed to grant, convey, transfer and assign to each of them a one-fourth share of interest in the said invention and in letters patent therefor whenever and wherever obtained.

"And whereas the said parties of the first part being desirous of raising a further sum of one thousand dollars for the purpose of obtaining letters patent from Washington and of making certain experiments, agreed to and did by the instrument herein recited grant, transfer, convey and assign seven thirty-fifth parts or shares in the said invention and in letters patent therefor whenever and wherever obtained to the following parties to wit: Rupert Mearse Wells, W. J. Gibson, George Trimble, E. Heimrod, Messieurs McMurray and Fuller, Emma Pepler and M. Sheppard, all of the said city of Toronto, J. E. O'Reilly of the city of Hamilton, and A. M. Sutherland of the town of Barrie.

"And whereas the said instrument is in the words and figures following, that is to say ................................ ...

"Whereas Dr. Woodward has invented a new and improved method of obtaining light by electricity, and has obtained letters patent for the said Dominion of Canada, and has made application for letters patent to the patent office at Washington.

"And whereas Matthew Evans, James Saurin McMurray, and Thomas Richard Fuller have each made advances to the said Dr. Woodward for the purpose of assisting him in carrying out the said invention, and are each equally interested with him therein.

"And whereas it is deemed necessary for the purpose of procuring the said letters patent from Washington, and for the purpose of making certain practical experiments with and trials of the said invention, to procure a further advance of one thousand dollars.

"And whereas the said Woodward, Evans, McMurray and Fuller have agreed to divide and apportion their interests in the said invention into thirty-fifth parts, so that each of the last named parties shall hold seven thirty-fifth parts or shares, and that the parties making the said new advance of $1,000, shall also hold seven thirty-fifth parts or shares therein, each new subscriber or contributor to have an interest in the seven thirty-fifths of the invention pro rata according to the amount of his subscription or contribution.

"And whereas the parties hereto hereby agree to the arrangement above mentioned.

"The said Henry Woodward, Matthew Evans, James Saurin McMurray and Thomas Richard Fuller, all of the city of Toronto, in consideration of the said new subscriptions to be obtained and of five shillings to each of them in hand paid, hereby convey, transfer and assign to the other parties hereto a seven thirty-fifth interest in the said patent or invention pro rata amongst themselves according to the respective subscriptions or contributions, and the said other parties hereby agree to pay to the said Woodward, Evans, McMurray and Fuller, for the purposes above mentioned, the amounts set opposite their respective names. And the said Woodward, Evans, McMurray and Fuller agree to use the said money exclusively for the purposes above mentioned in procuring the said letters patent from Washington, and for making the said experiments or trials. It is understood that so soon as the said subscriptions are made, all the parties hereto are part owners in the said patent or invention, and that their interests therein are as above set forth.

THE LATE MATTHEW EVANS.

"It is further understood that the Gramme electrical machine purchased by and imported from Paris by the said McMurray and Fuller, shall, in the event of the ultimate failure of the said invention, be the exclusive property of the said McMurray and Fuller, but in the event of success, it becomes the property of the partnership hereby created on payment of $1300.00.

It is further understood and agreed by and between the parties hereto that Dr. Woodward shall at once proceed to Washington for the purpose of procuring the said letters patent, and that the said experiments and trials shall be proceeded with continuously immediately after his return. And the said Woodward, Evans, McMurray and Fuller promise and agree with the other parties hereto that the said Woodward shall immediately after the said $1,000 shall have been subscribed, proceed to Washington, and shall, if possible, procure the said letters patent, and shall immediately, after his return, proceed continuously for a period of three months with the said experiments or trials, said experiments or trials being made with the view of practically proving that at least fifty electric lights can be shewn from the said machine at the same time.

"And they further agree that the said sum of $1,000 shall be sufficient for the purposes aforesaid.

"Dated at Toronto the fourteenth day of May, one thousand eight hundred and seventy five".

"And whereas the said instument is executed by all parties hereinbefore named

"And whereas the whole of the said one thousand dollars has been properly expended.

"And whereas it being desirable to raise a further sum of money by way of additional subscription for the purpose of taking out letters patent at Washington, the parties hereto of the second part have agreed, in consideration of receiving a further interest in the said invention and in the letters patent therefor whenever and whereever issued, each to advance to the parties hereto of the first part a further sum of thirty-three ($\frac{33}{100}$) dollars.

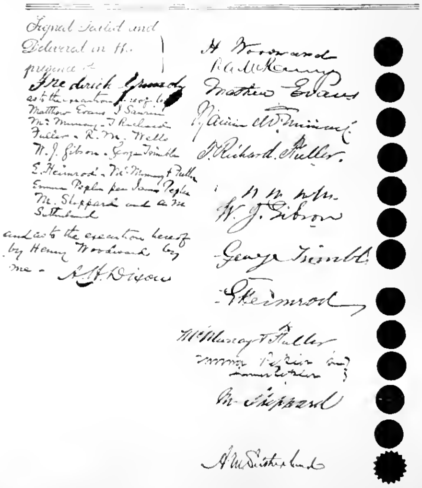
"Now this indenture witnesseth that, in consideration of the said additional subscriptions of five shillings to each of the parties of the first part, the receipt whereof is hereby acknowledged, the said parties of the first part, and each of them do hereby sell, transfer, assign and grant to the parties hereto of the second part their and each of their executors, administrators and assigns respectively, three thirty-fifth shares or parts in the said invention and letters patent in addition to the shares or parts granted and assigned by the said recited instrument.

"And whereas it is hereby agreed by all the parties hereto that the shares, parts or interests of all of the said parties in the said invention and in the letters patent therefor whenever and whereever the same may be issued, shall be as follows: the said Henry Woodward shall have own possession and be entitled to six thirty-fifth shares or parts; the said Matthew Evans to seven thirty-fifth shares or parts; the said James Saurin McMurray to seven thirty-fifths shares or parts; the said Thomas Richard Fuller to seven thirty-fifth shares or parts; and the said Rupert Mearse Wells, W. J. Gibson, George Trimble, E. Heimrod, A. M. Sutherland, Emma Peplar, M. Sheppard, and J. E. O'Reilly each to one thirty-fifth share or part, all of the said parties being joint and several owners and not partners, and for the purpose of more effectually vesting the said shares, parts or interests in the several parties entitled thereto, the said Henry Woodward hereby, in consideration of the premises, grants, transfers and assigns unto the said Matthew Evans, and to the said James Saurin McMurray, and to the said Thomas Richard Fuller, each of them their and each of their executors, administrators and assigns, seven thirty-fifth shares or parts in the said invention, and in the letters patent therefor, and to each of the following parties, namely, Rupert Mearse Wells, W. J. Gibson, George Trimble, E. Heimrod, A. M. Sutherland, Emma Pepler, M. Sheppard and J. E. O'Reilly their and each of their executors, administrators and assigns, one thirty-fifth share or part thereof, and the said Matthew Evans, James Saurin McMurray and Thomas Richard Fuller join and concur in the said grant or transfer to the said other parties and acknowledge the same to be valid and binding.

"And the said parties of the second part hereby agree to pay to the said parties of the first part each the sum of thirty-three ($\frac{33}{100}$) dollars, the receipt of the said Thomas Richard Fuller being a valid discharge therefor.

"And the said parties of the first part agree to use the said money exclusively for the purpose of procuring the issue of letters patent at Washington, and the said Henry Woodward hereby agrees after the issue of the said letters patent, to execute to the other parties hereto their and each of their executors, administrators or assigns, such further instruments and assurances for the better and more effectually conveying to them their said respective shares or interests as may be reasonably required or legally necessary."

In witness whereof the parties hereto have hereunto set their hands and affixed their seals:



Mr. A. M. Sutherland, one of the signers of the above agreement, in response to the request of a relative in Toronto for information on the subject, wrote as follows :

64 Carnegie Ave., East Orange, Nov. 24, 1896.

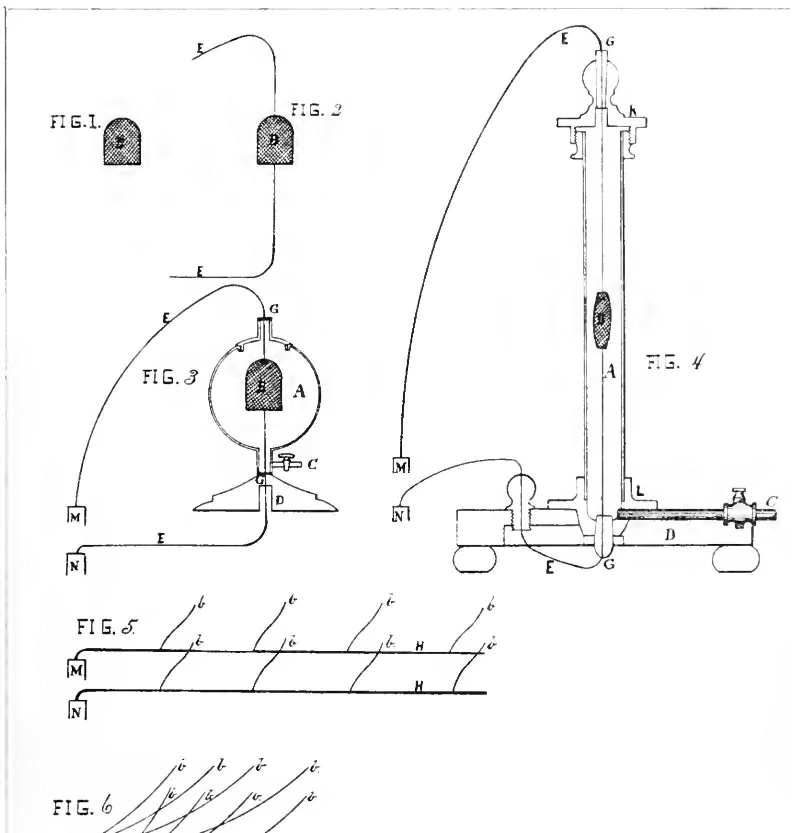
MY DEAR R———

M——tells me that somehow you came across a document signed by me some years ago showing some connection with electric incandescent light, and wishes me to tell you what I know of the matter. It is this. Somewhere between 1867 and 1875, I think it was, I was introduced by Mr. T. R. Fuller, a son of the late Bishop Fuller of Niagara, to a medical man named Woodward who was deep in the study of electricity. I was told that this gentleman had discovered two very important facts unknown to students of electric science, viz., the possibility of dividing the current, and the fact that placing a thin film of carbon between the poles in a circuit and enclosing the same in a vacuum would, by the incandesence of the carbon film produce a strong light. I recollected that a year or two before I had seen in the "Universal Exposition" at Paris a strong light shown by M. Gramme of that city, which was produced by an arc formed between the ends of two heavy carbon rods through which a very strong current of electricity was passed ; but the whole affair was so clumsy that I took very little "stock" in it. Therefore, when I heard that something neat and apparently serviceable was discovered by one near home, and that he wanted help to follow up his experiments and to obtain patents, I readily joined a number of friends and others and agreed to furnish the sum then supposed to be sufficient.

Two patents had been applied for in Washington at the same time for almost identically the same thing. One of these was Dr. Woodward's and the other was by a Russian whose name, I think, was Ladigan. Dr. Woodward and this Russian were declared in "interference" and had to fight each others' application before the patent authorities in Washington. Dr. Woodward won by proving priority of invention. After this it was found that so much money was required and apparently so little progress made towards completing the invention, that after our first investment, we decided to put in no more money until we could personally see the lights, which up to this time none of us had ever seen but had taken on faith. This displeased the inventor so much that he left for England and for years we knew

H. WOODWARD.

No. 181,613 ELECTRIC LIGHT. Patented Aug. 29, 1876.



nothing of his whereabouts. A few years after this I moved to New York, and in the course of business I was thrown into more or less intimate relationship with the now famous electrician, Thomas A. Edison, who was at that time experimenting with the electric incandescent lamp at Menlo Park, N.J. In talking about it one day, I chaffingly said: "Why Edison, you are nowhere! I am part owner of a patent several years older than yours on about the same thing you claim." He asked what patent I referred to and I told him, he remarking: "O, I know that patent, it is no good." The next day one of Mr. Edison's men, whom I knew very well, asked me how much I would take for my claim in the Woodward Patent, and that day I sold it to this gentleman, who in turn made over the papers to Mr. Edison. This is all.

Yours truly,

(Sgd) A. M. Sutherland."

UNITED STATES PATENT OFFICE.

Henry Woodward, of Toronto, Ontario, Canada, Assignor, Mesne Assignments, To Rupert Mearse Wells, Thomas Richard Fuller, and Ernest Heimrod, of same place, and Charles H. Woodward, of Lindsay, Canada.

IMPROVEMENTS IN ELECTRIC LIGHTS.

Specification forming part of Letters Patent No. 181,613 dated August 29, 1876; application filed Jany. 4, 1875.

To All Whom It May Concern:

Be it known that I, Henry Woodward, of the city of Toronto, county of York, in the province of Ontario, Canada, have invented new and useful improvements in the art or process of obtaining artificial light by means of electricity; and I do hereby declare that the following, taken in connection with the drawings which accompany and form part of this specification, is a description of my invention sufficient to enable those skilled in the art to practice it.

In the first place, I use a gas engine or other suitable motive power, for the purpose of rotating a magneto-electric machine, and at such a velocity as shall create electricity sufficient to heat certain pieces of carbon hereinafter described. The magneto-electric machine should be of sufficient power for the purpose of heating the carbon to a state of incandescence. A piece of carbon of suitable size is scraped and shaped until fitted for the purpose; one pole is then attached to the top of the carbon, and the other to the bottom thereof, by suitable electrodes. It is then enclosed in a globe or other vessel, either of glass or other suitable material. The air is then exhausted from the said globe or vessel after it has been hermetically sealed at the ends, and the globe is then filled with a rarefied gas that will not unite chemically with the carbon when hot. Electricity is now supplied, and in sufficient quantity to heat the carbon within the vessel to a state of incandescence. The rarefied gas previously introduced now becomes luminous, and constitutes the light herein designated as "Woodward's electric light."

This arrangement and process will give a light of any required intensity, and there is, practically, no limit to the number of lights that may be obtained from one magneto-electric machine.

In the accompanying drawings, the same letters of reference indicate the same parts in all the views, and also in this specification.

Figure 1 is an elevation or front view of a piece of carbon, and is marked B. It is supposed to be scraped and shaped until suitable for the required purpose.

Figure 2 is also an elevation or front view of a piece of carbon with the electrodes E.E. attached thereto leading to and from the positive and negative poles of the battery, one being attached at the top and the other at the bottom of the carbon.

Fig. 3, is a sectional elevation, showing a globe marked A, but which may be a vessel of any other suitable form. The prepared carbon, B, is also shown therein with the aforesaid electrodes E.E. attached thereto; showing also a tube C, with an air-tight stop-cock, to be used in exhausting the air from the globe A, and for the injection of rarefied gas into the same; showing, also, the hermetical sealing of said vessel at the ends G.G. of the tubes, and showing also the stand D.

Fig. 4 is a sectional elevation, showing the adaptation of another form of vessel, A. This drawing is on a larger scale, in order to show the manner of closing the ends of the vessel which is done by brass sockets; that at the top being marked K, and that at the bottom being marked L; showing also a carbon B, different in form from that in the other vessel, and having the two electrodes E.E. running to and from the poles N and M.

Fig. 5 is an elevation, showing one mode of connecting the various lights with the machine by means of two trunk wires or electrodes H.H. running from the positive and negative poles M and N of the machine, with branches b, b, &c., therefrom, to each light.

Fig. 6 is also an elevation, showing another method of connecting the lights with the machine, each light having a distinct wire b, running to each pole M N of the machine or battery. Having thus described my invention, I claim—A carbon B, in combination with a lamp or other suitable vessel, A, filled with rarefied gas, possessing the property of not chemically combining with the carbon when in a state of incandescence, in connection with the described arrangement and mode of connection of the electrodes E.E. with the carbon, all as shown and set forth.

Henry Woodward,

Witnesses { William Fitch, George T. Smallwood.

The first incandescent lamp was constructed at Morrison's Brass Foundry, Adelaide St. West, Toronto, and was a very crude affair. It consisted of a water gauge glass with a piece of carbon filed by hand and drilled at each end for the electrodes and hermetically sealed at both ends, having a petcock at one end with a brass tube to exhaust the air. Woodward made the mistake of filling the tube or globe of this lamp with nitrogen after having exhausted the air. If, as Professor Elihu Thomson has said, he had stopped when he had the tube exhausted, he would have had the honor of being the inventor of the incandescent light as used for commercial purposes.

Six of these primary lamps were made up and connected in series. Evans was accustomed to tell of the excitement which attended the watching of these lamps coming to incandescence. To use his own words, "There were four or five of us sitting around a large table, Woodward at the head. The six lamps were strung in series from two supports on the table. Woodward closed the switch and gradually we saw the carbon become first red and gradually lighter and lighter in color until it beamed forth in its beautiful light. This was the most exciting moment in my experience." Evans was also accustomed to express the opinion that the inventor never gets the reward of his labor, and that by right he should have been the man to reap the benefit of this invention, in the perfecting of which he had expended $20,000.

As the result of his experiments, Woodward decided that a much stronger battery would be required to obtain the desired effect, and in company with Evans he went to New York City to see what they could obtain in the shape of a stronger machine. Finding that such a machine could not be obtained in New York, Woodward was dispatched to Paris to obtain, if possible, from M. Gramme a machine that would do the work. He was absent four months and succeeded in purchasing a machine from Gramme which he shipped to Toronto by sailing vessel. The arrival in Toronto of this machine gave rise to much excitement among the electrical fraternity of that day. The machine stood about four feet high and cost £500. One of similar capacity could be bought to-day for $35.

The machine was first tested on the premises of a hardware company on King St. West, near the Gurney Foundry Company's premises. Permission was obtained to couple the machine on to a line shaft which was propelled by a 60 h. p. engine, but on attaching a single light to the dynamo the engine was immediately shut down or the belts thrown off. Finally the machine was made to run successfully a single arc lamp which, as above stated, was of very crude construction and was

controlled by hand feed. The machine was supposed to have a capacity sufficient to operate 50 incandescent lights. The single lamp, backed by a reflector, gave out such a strong light that Evans declared that the street car horses stopped opposite the building in which it was, while people from the surrounding neighborhood ran over to the factory, thinking it was on fire. The machine, however, would never run more than one light at a time. This first arc lamp was invented by Woodward also, and is said to have been manufactured by a machinist named Nesbitt. Woodward and Evans were the subject of much public ridicule, being frequently called "cranks." After the invention had been thus far tested, outside capital was obtained, and a company formed for the supply of incandescent and electric lights to the city and private individuals. It is interesting to note from Mr. Sutherland's letter that some of the original stockholders put money into the enterprise before having ever seen the light, and that when they declined to put up more money on the same conditions, Woodward became much displeased and left for Europe.

Dr. Woodward is said to be now residing in London, Eng., while Mr. Evans, who was his partner, and whose portrait accompanies this article, died in Toronto last year.

We are indebted for much of the above data to Mr. J. J. Wright, manager of the Toronto Electric Light Co., and Mr. Patriarche, of the Electrical Maintenance Company, Toronto, who sometime ago purchased the original of the agreement printed above, and other documents relating to the subject.

## QUESTIONS AND ANSWERS.

Subscriber writes: Will you kindly answer the following questions in the next issue of The Electrical News:

1. What is the situation of Shawenegan Falls, where the new power plant is to be located.

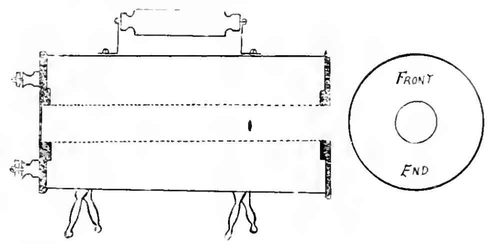
2. Where did the name of "Bus-bar" originate, and why is this term used? I have noticed that English electrical papers term it "Ominbus-bar."

3. What length and size of wire would be required for winding a curling tong heater for 114 volt circuit?

Answer.—1. The St. Maurice river, as is well known, is one of tne most important northern tributaries of the St. Lawrence, emptying into it at Three Rivers, Que. Seventeen miles from the mouth of the St. Lawrence is located Shawenegan Falls, where the water power development has been undertaken. These falls are, therefore, about 90 miles distant from the city of Quebec and 4½ miles from the line of the Great Northern Railway, while the Canadian Pacific Railway passes within ten miles of the falls. A map showing the proposed development of the falls appeared in The Electrical News of March, 1899.

2. It is difficult to say just where the name "Bus-bar" originated. It was used in the early days of the incandescent light and signified the common bar to which the terminals of all dynamos were attached and from which all circuits extended. The word is shortened from omnibus, which is Latin, and the dative case of the pronoun omnes, signifying "all." Omnibus, therefore, is literally "for all." Hence also its application to the well known vehicle of that name.

3. If our correspondent will take about 35 feet of No. 24 or 25 B. & S. gauge German silver wire, wind same on a piece of brass tube of sufficient diameter to admit of entering the tongs, and sufficient length to admit of their heating ends, previously wrapping the pipe over with a layer of asbestos cloth, he will then have accomplished the bulk of his task. The wire, of course, should be uninsulated, and space should be left between each convolution as it is put on. The wire will have to be drawn on quite tightly (not sufficiently so to cut through the asbestos), as it will expand slightly when the current is on. As all the wire will probably not go on one layer, repeat the process, that is, cover the first coil with asbestos and wind back on top again, and so on until the length of wire is all coiled. Bring the start end and finish end to binding posts on the outside of the outer shell, said binding posts being insulated from the shell with mica washers, and mica or fibre tube around the screw. If the bare wire comes close, or if you require to make a cross-over, use pieces of clay pipe stem to insulate one from another. When finished the coil should have an outer layer of asbestos, and any further space can be filled up with asbestos clippings so as to keep the heat in as much as possible. The accompanying sketch shows the finished article, dotted lines show-




ing inner tube on which asbestos and German silver wire are placed. It will be observed that the whole can be made out of brass tubing of suitable diameter, and the ends cut from thick brass sheet. Do not solder anything, as it will melt; tap and thread one into the other, or fasten pieces with machine screws.

Note.—An easy method to ascertain the amount of wire required for any heating device is as follows: First determine on a size that will not take too much current for the work to be done; then stretch out a quantity (be sure there is not too much) on pins spaced along a board, take wires from current supply, attach one to one end of this spaced out German silver wire, use the other end as a sliding contact, beginning at distant end and sliding it along the wire, which, of course, becomes hotter and hotter as resistance is being cut down, until the wire assumes a blue shade owing to heat. Stop then, and cut off the piece between the current contacts and use it for your heater. When enclosed from air it will be hotter, therefore we advise stopping when it assumes the blue shade.

## PERSONAL.

Mr. James A. Hicks has been appointed electrical inspector in Montreal for the Royal Electric Co.

Mr. J. M. Clark, a director of the Smith's Falls Electric Light & Power Co., and a prominent business man of that town, died last month.

Mr. George White-Fraser, E.E., has returned to Toronto, after an absence of more than one year in the Yukon district on a government commission.

We learn with regret of the death, on January 9th, of Mr. Jas. D. Smith, of this city, father of Mr. J. Norman Smith, electrical engineer of the United Electric Co., Limited.

Mr. R. A. Ross, of Montreal, consulting electrical engineer of the C.P.R., recently left for Rossland, B. C., to inspect the plant installed at the company's round house there.

Mr. Joseph Lappin has resigned his position as electrician for the Metropolitan Railway Company, of North Toronto, and is now in the employ of the Canadian General Electric Company.

Mr. D. A. Shiles, traffic manager at Vancouver for the British Columbia Electric Railway Co., has been transferred to New Westminster, as local manager there, and is succeeded by Mr. J. J. Franklin.

Mr. Mark. B. Thomas, who was manager of the Hamilton & Dundas Railway, which road has passed into the hands of the Cataract Power Co., has been appointed to a responsible position in connection with the street railway system of this company.

Archibald Rowan, inspector of gas and electric light at St. John, N.B., died in that city on January 10th, at the age of 70 years. He was appointed to the above position in 1875, previous to which time he had been prominent in civic affairs and a candidate for the mayoralty.

Mr. Herbert J. Somerset, manager of the Winnipeg Electric Street Railway, has accepted a lucrative position as general manager of the tramways at Perth, West Australia. Mr. Somerset was much esteemed in Winnipeg, and carries with him the best wishes of numerous friends.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.

NEW YORK LIFE INSURANCE BUILDING, MONTREAL.
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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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TORONTO—O. P. St. John, A. M. Wickens, A. E. Edkins, J. G. Bain, F Donaldson.
HAMILTON—Robt. Mackie, Thos. Elliott.
BRANTFORD—A. Ames, care Patterson & Sons.
LONDON—F. G. Mitchell.
OTTAWA—Thomas Wesley.

Information regarding examinations will be furnished on application to an member of the Board.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

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**Electric Light Invention in Canada.**

WE are privileged to publish in this number some interesting data regarding the history of the invention of the electric light. Canadians will no doubt be surprised to learn that the principle of incandescent electric lighting was discovered in Toronto prior to the time when Edison's invention was placed before the public, and that this Canadian invention was sold to Mr. Edison, and were no doubt used by him in the further exploitation of his inventions and discoveries. We are largely indebted for this interesting data to Mr. J. J. Wright, manager of the Toronto Electric Light Company, himself a pioneer in the electric light industry, and to Mr. Patriarche, manager of the Electrical Maintenance Company, who secured much of the information by personal interviews with Mr. Matthew Evans, one of the original promoters of the discovery. It is gratifying to learn that Canada is not only the scene of some of the greatest achievements in the applications of electricity, but is also the home of some of the most important discoveries relating to the science.

**An Incident in Electric Lighting.**

THE accident which caused the death of Mr. Alphonse Girouard, and which is referred to by our Montreal correspondent is, to say the least, peculiar, and so far as the electrical fraternity is concerned, no entirely satisfactory explanation has been given. It appears that two rival electric lighting companies had their primary alternating lines, operating under a pressure of 2,000 volts, in close proximity. This voltage in some way came in on the secondary mains, which normally were at 52 volts. The theory is advanced that the primary wire came in contact with a guy wire, and this in turn with secondary supply wires, bringing the 2,000 volts in on one side. In order to permit of the accident, the inside wiring must have been grounded, so it is surmised that the deceased stood on an iron rail in front of the hotel bar to raise himself up sufficiently to grasp the socket. Rain was falling and a strong gale of wind blowing at the time, and it is possible that the wind may have blown the dangerous wire into contact, as the trouble patrols were unable, shortly after the accident, to find high voltage in the premises. It has not been ascertained whose primaries caused the accident or how they came in contact with the secondaries. The transformers are reported to have been in good order. The accident is unfortunate, as it already has had a tendency to make customers afraid to turn on their sockets. It may truly be said, however, that the peculiar combination of conditions which resulted in this accident will very rarely be met with, and are almost impossible in dwelling houses. Nevertheless, it is in the interest of electrical progress that the matter should be thoroughly investigated and all the facts concerning the case placed fairly before the public. This will be the best means of dispelling prejudices against electricity based upon erroneous versions of this accident.

**Central Station Practise.**

THE address of the president of the North-Western Electrical Association, delivered at the eighth annual convention held in Milwaukee on January 17th, contains food for thought for central station managers. His remarks were confined to a review of the conditions surrounding the operation of central stations. The changes in practice to which he refers have had practical

demonstration in Canada as well as in the United States, and the suggestions offered regarding operating methods are likewise applicable on this side of the border. Sketching the progress made in central station machinery, Mr. Doherty expressed the opinion that the constant current transformer is here to stay, and that street illumination by series alternating enclosed arc lamps is a decided improvement over the old series direct-current open arc. The distribution of light is materially improved and a more uniform illumination obtained. Instances are cited where two central stations had adopted gas engines as prime movers, using sizes as high as 650 h.p. It might be mentioned that in Ontario the Sandwich, Windsor & Amherstburg Railway Company have just installed a 150 horse power gas engine for operating their electric road, to replace a Corliss steam engine. The president referred to the necessity of a better distribution of street lighting, and his opinion is that this may be accomplished by the greater use of the incandescent lamp. He thought there had been little improvement in the past few years in direct current methods, but this could not be said of alternating current appliances and methods. In the past, "unaccounted for current" in alternating current stations had often amounted to 80 per cent. of the output, but modern transformers, up-to-date methods and equitable rates promised to reduce this loss to an almost negligible quantity. The average central station was handicapped for four reasons, namely, improper and insufficient education of operators, poor accounting, lack of capital, and inequitable rates. He strongly recommended the further education of present employees. When speaking of employees, Mr. Doherty might have gone further and said that the remuneration which is sometimes given to those in charge of electrical apparatus is not such as could be expected to induce such persons to put forth their greatest efforts towards self improvement and the welfare of the business. The subject of municipal ownership was discussed at some length. The conclusion reached was, that the main protection against municipal control lies in educating the people with regard to its fallacies.

**The Proposed Dodge Telephone Company of Canada, Ltd.**

WE have had the opportunity of examining the prospectus of the Dodge Telephone Company of Canada, Limited, and the circular letters accompanying the same. Some of the features of this prospectus seem to call for particular mention and enquiry. The first of these is, that, while the company has not yet been granted a charter or completed its board of directors, it is soliciting from the public applications for stock, such applications to be accompanied by a deposit of 10 per cent., a further payment of 25 per cent. to be made upon allotment, and the balance subject to call as required. These deposits accompanying applications for stock will, it is stated, be deposited in the Imperial Bank of Canada in Toronto in the name of the trustee of the proposed company. We do not observe that the name of this trustee is printed in the prospectus. The only names there printed appear to be those of the bankers, the solicitors, and the promoter of the proposed company. Can a company thus organised legally accept applications for shares and payments on account of stock thus applied for? The prospectus states: "The ordinary telephone system has been materially improved by Mr. Burton R. Dodge, of Post Mills, Vermont, an inventor of marked ability, and a gentleman possessed of a lengthy experience in the practical operation of telephone lines. These improvements are completely protected by patents; the number of his Canadian patent being 60,912, and of the United States patent 606,803. And it is now proposed to incorporate a company under the Joint Stock Companies Act to operate Mr. Dodge's improved invention in the city of Toronto, and elsewhere in the Dominion of Canada, with the ample capital of $3,000,000, divided into 3,000,000 shares of one dollar each. One-half of this gross number, or 1,500,000 shares, will be set apart in 8 per cent. fixed, cumulative preference shares dividends payable half-yearly; and the remainder, the other 1,500,000 shares will be written as ordinary stock under the direct control of Mr. Burton R. Dodge, his heirs, or assigns." If we rightly understand the meaning of the latter clause of the above paragraph copied from the prospectus of the proposed company, the purchase by Mr. Burton R. Dodge of a single share of stock, in addition to the 1,500,000 shares which are to be transferred to him in exchange for the use of his patents, would give that gentleman entire control of the company. This understanding of the terms of the prospectus seems to be verified by the following additional clause in the prospectus: "A rapacious and unscrupulous monopoly has in various instances elsewhere destroyed all immediate chance of competition, either by buying up a controlling interest in the stock, or by paying a lump sum for the stoppage of the business; and with the view of preventing such a culmination in connection with the operation of this company, Mr. Dodge will retain the controlling interest in the stock." Another clause to which we desire to direct attention reads as follows: "All applications for shares should be made upon the form attached to this prospectus, and should be promptly forwarded to the bankers of the company, together with the ten per cent. payable on application. But if no allotment of stock be made, such deposit shall be returned less such expenses as may be incurred up to that time." It is here clearly stated that the company assumes the right, even in cases where no allotment of stock is made, to retain such amount of the applicant's deposit as may be considered necessary, to be applied to the payment of expenses incurred. What is to regulate the amount of the expenses, and what guarantee has the applicant that the whole of his deposit will not be held by the company and applied to expense account? What right has a company to retain the money of an applicant whose application for stock has not been granted? The form of application for stock reads as follows: "I hereby request that you will allot me .... shares of one dollar each in the proposed Dodge Telephone Company of Canada, Limited, upon the terms and subject to the conditions mentioned in the prospectus." Thus, the applicant for stock, when signing his application agrees that the stock shall be issued "upon the terms and subject to the conditions mentioned in the prospectus." It would be interesting to learn how many applications for stock have been received by the promoters of this proposed company.

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Mr. Thos. Jackson, for fourteen years manager at Stratford, Ont., for the Bell Telephone Co., has retired, owing to advanced years. He has been succeeded by Mr. J. H. Martin.

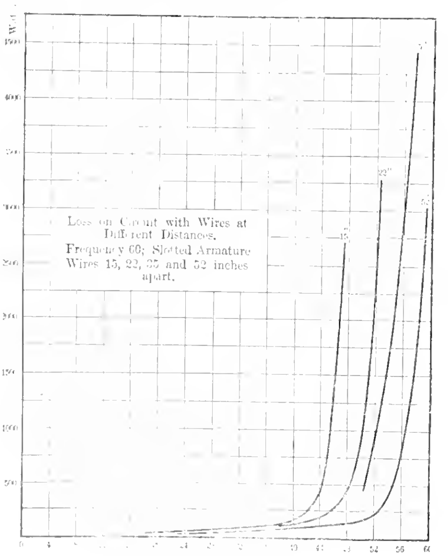
## ELECTRIC POWER TRANSMISSION.

The publishers of the Electrical World and Engineer, New York, have issued a second edition of that valuable work "Electric Power Transmission," by Louis Bell, Ph.D., Mem. Inst. Elec. Eng. The first edition was printed in January, 1897, and was very favorably received, but the changes that have taken place since in the art of electrical power transmission called for another edition. The book contains fourteen chapters, classified as follows: Elementary Principles; General Conditions of Power Transmission; Power Transmission of Continuous Currents; Some Properties of Alternating Currents; Power Transmission by Alternating Currents; Current Reorganizers; Prime Movers; Hydraulic Development; The Organizations of a Power Station; The Line; Line Construction; Centres of Distribution; The Commercial Problem; The Present State of High Voltage Transmission. In this latter chapter is recorded such change in practice as has taken place during the three years intervening between the two editions. The most important advance, it is stated, has been in the matter of power transmission at very high voltage and to long distances.

By permission of the publishers we give below extracts from this chapter:

Much of our knowledge of the subject is due to the exhaustive tests made by Mr. Ralph D. Mershon at Telluride, Col. These are fully described in a paper by Mr. C. F. Scott before the American Institute of Electrical Engineers. Briefly, the essential points established are as follows:

With first-class glass or porcelain insulators there is little to fear in the way of leakage in good weather up to say 50,000 volts, unless the insulators break from mechanical causes. Rain and snow seldom cause trouble, although of course they may do so. Dry air, snow and clean water are tolerable insulators, although dirt of any kind on the insulators is to be feared. Cross-arms and pins should be filled to prevent infiltration of moisture. There is good reason to believe that oil insulators are quite needless, and they certainly are apt to

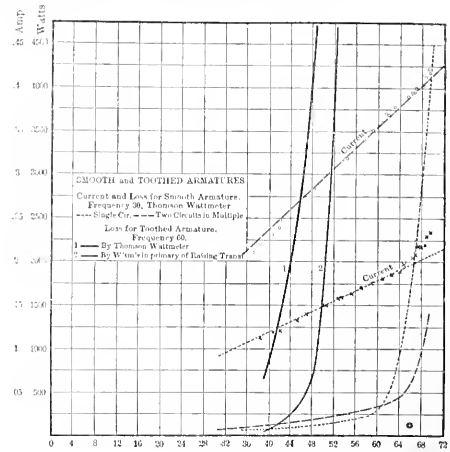



Thousands of Volts.

FIG. 1.

accumulate dirt without giving any compensating advantage.

Loss of energy through leakage over the surface of the insulator is very trifling perhaps not more than two or three watts per insulator, even at 50,00 volts between lines. In bad weather this is likely to increase; but the leakage itself tends to dry the surface of the insulators, and while if high voltage is suddenly thrown on a line leakage may cause immediate trouble, gradually raising the pressure to the full working point tends to correct this difficulty, and there is no trouble experienced. Rain is the only thing likely to cause difficulties, unless we except a heavy snow storm, and neither is much to be feared at 40,000 to 50,000 volts, although above this point troubles increase rapidly. A heavy sea-fog, with salt-laden atmosphere, is serious, however, as has been shown on lines of far lower voltage than the above, and sometimes has caused the burning of pins, cross-arms,




Thousands of Volts.

FIG. 2.

and even poles. Sappy cross-arms and poles have been a not uncommon source of damage.

The most interesting fact brought out in the Telluride experiments was the leakage at very high voltage between wire and wire through the air—a true brush discharge akin to that seen about the wires proceeding from a big induction coil. At about 20,000 volts the line wires begin to show at night traces of luminosity, which rapidly increases with the pressure, until at 50,000 volts and upward the wires are plainly visible for a long distance, and the hissing sound characteristic of fierce brush discharges is audible at the distance of a hundred feet or more. This discharge involves a real and quite considerable loss of energy, increasing with appalling rapidity at still higher voltages. This loss increases with rise of voltage, with diminution of the distance between wires, and with diminution of the diameter of wire. Anything on or about the wire which increases the electric density at any point shows as a noticeable brush discharge. Fig. 1 shows the loss on the Telluride circuit, 2¼ miles in total length, with line wires at different distances apart on the poles. The curves begin to turn upward at between 40,000 and 50,000 volts, and, once the elbow of the curve is past, rise very fast.

It is clear that this phenomenon sets a real physical limit on high-voltage transmission of a sort not hitherto realized. A loss of say 2 k.w. per mile of wire is a pretty serious matter on a long line, even when the total energy transmitted is very considerable, and obviously in any practical case of transmission the voltage must be kept well below the elbow of the leakage curve. Hence the wires should be kept well apart.

As might have been expected, the shape of the E.M.F. wave given to the line is a very important matter under these circumstances. Fig. 2 illustrates this fact in a sufficiently startling manner. By changing from a non-sinusoidal wave of the peaked type to a wave nearly sinusoidal the elbow of the curve was pushed up from 40,000 volts to 60,000 volts under conditions otherwise the same. For such work there is every possible reason for using the sine wave on account of this leakage effect as well as for other practical reasons already set forth. But even with favoring conditions leakage must be reckoned with, and present data indicate that in nearing 50,000 volts one is on dangerous ground quite aside from any questions of insulators or apparatus. We cannot expect to improve the dielectric strength of the air, and although the conditions may

be improved by using good-sized wires when conditions permit, or perhaps by heavily insulating the wires, thus both increasing their diameter and somewhat improving the general insulation, it is quite probable that a limitation of voltage from this cause is an unpleasant reality.

With proper precautions, however, there seems to be no very grave difficulty in working at 40,000 to 50,000 volts. Besides the Telluride experiment, in which the short line mentioned was worked steadily for a month at 50,000 volts without serious interruptions, there has now been in operation for over a year a commercial transmission over 55 miles at a working pressure of 40,000 volts. This is the plant of the Telluride Transmission Co. at Provo, Utah. The power is utilized for driving the Mercur mills and other work in connection with a large mining property. The generating plant consists of a pair of 750 k.w. three-phase generators, directly connected to turbines. They run at 300 r.p.m., giving 60 alternations, 800 volts. The raising transformers of 250 k.w. each are set up in the star connection with the neutral points of both primary and secondary grounded. The line involves a rather tough bit of mountain construction, reaching an extreme altitude of over 10,000 feet. The insulators are of glass and of ample dimensions, 7 inches in diameter.

This plant has done good steady work ever since it was started. It has not been exempt from troubles, of course, but there have been no serious breakdowns.

In ordinarily dry weather the line has uniformly worked well—as well as lines at a much lower voltage. In rainy weather there has been some trouble from leakage, sometimes enough to blow the fuses. In almost every instance of line trouble the cause has been found to be a broken insulator—cracked from strain or smashed by a bullet. The first time the author crossed the continent on power transmission business he received a vivid idea of the bullet as a factor in the situation, for nearly every switch target between Kansas City and Los Angelos had from one to a dozen bullet holes in it.

The Provo plant has been in operation since February, 1898, and in spite of the terrific voltage and occasional difficulties on the line it has done, and is doing, exceedingly good service. Such pressure, however, must be regarded as somewhat experimental, and it should be borne in mind that the kind of work on which it is employed is such that trivial disturbances are not noticed much, and brief interruptions at infrequent intervals are not serious—simply annoying. What a similar plant would do in the way of furnishing a general service of light and power is still problematical.

An innovation which has found some favor is the use of generators wound to deliver directly 10,000 to 12,000 volts. Such machines are always built with stationary armatures and revolving fields. Prior to the introduction of this construction, generators for such pressures were out of the question, but there are now in use eighteen of these high-voltage machines, nearly all above 500 k.w. capacity, which are uniformly doing good service. The ultimate economy of this practice is not yet clear. One set of transformers is saved, reducing the loss about 2.5 per cent., while on the other hand the very large insulation space required tends to considerably reduce the capacity of generators of given dimensions. Exact figurrs cannot be had, since the intrinsic merits of the matter are mixed up with commercial considerations involving the competitive and advertising value of novelty, the question of adaptation of standard sizes and speeds, and other matters which are of temporary rather than permanent importance. It is the author's impression, however, that when these matters are eliminated there will prove to be little or no difference in cost, including depreciation and efficiency, between the high-voltage machine and a low-voltage one plus the raising transformers. At present, inasmuch as the high-voltage generators are excellent and reliable machines, their use is advantageous so long as a good bargain can be driven as to price as compared with the low-voltage machine and its raising transformers. Although none of these high-voltage generators have been long enough in use to get a definite idea of their liability to electrical troubles, there is not much to be feared in view of our present knowledge of insulation.

The phenomena of line capacity and inductance, resonance, unbalancing of three-phase transmission circuits, and divers other unpleasant things which are theoretically present on long-distance or high-voltage lines, have been shown by experience to be of no sensible account in a well designed and constructed plant. Line inductance and the rest are, of course, always with us, but from an operative standpoint they are not at all serious at any pressure or distances now in use. They must be considered and taken into account just like ohmic resistance and line insulation, but are not material obstacles at any voltage or distance yet tried.

As regards the generation and distribution, the work in this country is about equally divided between the two-phase and three-phase systems, the latter being rather in the majority. As might be anticipated, there is found very little difference in the general properties of the two systems, the tendency being to use two-phase in many cases where an existing alternating lighting system is to be supplied, and three-phase for heavy motor work or when the whole system is installed de novo, although neither this nor any other plan is consistently adhered to in practice.

The generating and transforming units have been steadily increasing in voltage and capacity. Some 2,500 k.w. transformers have recently been ordered for the Niagara plant, while those of several hundred kilowatts are common enough. Barring the general objection to putting too many eggs in one basket, this tendency is a good one, giving units at once cheaper and more efficient.

Accessory apparatus has hardly kept pace with the general progress of the art. Switchboard appliances for high-voltage work are notably undeveloped into standard forms. They have particularly suffered from the too common straining after compactness. A liberal factor of safety is always a good thing, and nowhere is it more necessary than in dealing with voltages such as are used in electrical power transmission.

The question of frequency is gradually settling itself. Except in plants intended mainly or entirely for use with rotary converters, a frequency of about 60 alternations is the general rule, and this is the figure adopted in the great majority of transmission plants. In those intended for general distribution of power and light, the lighting sets a lower limit to the frequency that must be respected. In the neighborhood of 30 alternations incandescent lighting becomes decidedly troublesome, and if alternating arcs are to be used the frequencies must be kept above 40 alternations. On the other hand, induction motors give the best results at moderate frequency, say not over 50—60 alternations at the most. All these facts point to the advisability of keeping within moderate limits, and the usual 60 alternations is for moderate distances and ordinary distributions very satisfactory. In the writer's judgment, it is rather high for heavy long distance work—45 or 50 alternations would be rather better, but there is no excuse whatever for going as low as 30 alternations except when rotary converters are the principal load and no lighting whatever is to be done for the transmission lines.

In this connection it is well to call attention to the fact that alternating arc lamps, particularly of the inclosed type, are now in a fairly satisfactory state, and that the series arc is being very largely replaced by constent-potential arcs, often inclosed, working off the ordinary lighting system. It therefore appears probable that special devices for arc lighting will form a less troublesome feature of transmission work than hitherto.

The induction motor has come into wider and wider use as transmission plants have increased in number, and particularly the larger sizes have been well developed. These very large induction motors are particularly valuable for hard service and starting with considerable loads, although in view of the value of synchronous motors in improving the power factor of transmission plants, these latter machines are not likely to be entirely superseded.

# MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
New York Life Building,

FEBRUARY 6th, 1900.

The Star's recent editorial anent recent civic elections is all very well in its way, but some of the "electrical" items in same are worthy of comment. Take overcrowding of cars: This is the "whole truth and nothing but the truth," and the systems at Ottawa, Quebec, and Toronto simply make Montrealers ashamed of their's. To see a car going up Windsor street hill with the back platform so overwhelmed with humanity as to cause the rear fender supports to scrape on the cobble stones (in some cases even the rear lower step is scraping on the ground), is disgraceful, to say nothing of the rear motor then doing 70 per cent. of the work and the front motor nearly lifted off the rails. To say that the public won't stop getting on is absurd; if the conductor refuses to move his car until late crowders step off, the balance of the passengers inside would probably take care of the result; if not, then call a policeman, and in Montreal—CALL LOUD. Then cheap light. This item deserves a word of protection for the illuminating companies. As to public arc service it is an open rumor that it cost so much to secure the contract that even at alleged high figures there has not been much profit in it for the company who got it. Taking the incandescent service, it is well known that there are two large competing companies, both basing their price list at ¾ of a cent per ampere-hour at a pressure of 50 volts, one company offering a cash discount of 33⅓ per cent., and the other 40 per cent. Surely there is not much to complain of here, and I think other cities will agree with this, and wish they were as well fixed. The question of power rates for motors has not been touched upon, but here again there is little or no cause for complaint. We may be higher than some other cities for small power units, say from ½ to 3 h. p., but for large powers we are certainly as good, and for extra large motors away better off. Lastly, be it remembered that our city council are doing their best to tax everything, almost down to the glass insulators and tie wires.

A shocking accident was that which resulted in the death of Alphonse Girouard a hotelkeeper, doing business at 176 Vinet street. It seems that the wife of the deceased, while about to turn on an incandescent light, felt a slight electric shock. Calling her husband, she asked him to turn on the light. He had no sooner taken hold of the lamp than he sank down with a groan. The electric current held him so fast that the assistance of three men was required to extricate him. Before a physician arrived he had expired. The accident is attributed to the crossing of a high pressure wire with the wire which entered the house of the deceased. An examination of the premises failed to disclose the cause of the accident, and it is more than likely that this matter will never be fully explained, as well as others, such as: why insurance inspectors should be so particular as to fire risk without looking at life risk; why lighting companies should be so careful to have porcelain tubes, etc., yet not look out for "grounds;" why the process of resuscitation is not resorted to, and promptly, to persons hurt in this manner.

The Bell Telephone Company have lately installed a private exchange for the Merchants CottonCompany in this city; the signals in some departments being inaudible owing to the rumble of machinery, here take the form of a relay drop closing a circuit through a red lamp, thus making a visual signal that party is desired.

It would be interesting to know just what is the longest distance we can talk to direct over the Bell Telephone Company's wires with success. Perhaps some of the readers in their employ will enlighten us. In a recent advertisement the Bell people couple Quebec with Omaha and Montreal with Key West, which, of course, can be taken "cum grano salis," but if going in for "so much" they might as well be killed for a sheep as a lamb, and make it Winnipeg with Valparaiso.

The order for a 600 k. w. D.C. A.C. generator, secured by the Westinghouse people from the Quebec Street Railway and Light and Power Co., has been filled. It is understood that this generator will be installed at the power house adjacent to Montmorency Falls and utilized to run the trolley road to St. Annes de Beaupre, that is, as soon as the old Quebec, Montmorency and Charlevoix Railway is arranged for electric transportation instead of steam. The generator in question is said to stand 14 feet in height. A "rotary" will probably be placed at the St. Annes end of the line, with usual step-up and step-down transformers for suitable voltages.

The astonishing electrical activity last fall (as foretold by your correspondent) is only now beginning to abate. The mild weather was a boon to construction firms, as it is impossible to expect wiremen to get through the usual amount of work in a given time with their fingers half frozen. Complaints as to fall business are not forthcoming from either the supply men or construction firms, and the outlook for the balance of the winter (generally a slack time) is more favorable than is usually the case.

Instead of the expensive alarm clock bell ringing outfits, if one with any knowledge of electricity will only remember that the winding thumb key on all nickle alarm clocks keeps turning when the alarm is ringing, he can easily use it to operate some form of circuit closer, and with the addition of a few feet of wire, a bell and dry battery, have a good "awakener."

Would the Boers be "shocked" that the Hague Conference had overlooked this? Coulpe arc light dynamos used for the search light, in series, "to required voltage," ground one pole, and connect the other to the protective enclosure, viz., barb wire fence!

Square wire is coming into vogue largely for the purpose of increasing the kilowatt capacity of certain alternating generators which have machine wound coils, allowing of such an exchange being made. It is easily seen that the corners being filled in is quite an advantage over the ordinary round wire, and in many cases the gain is great enough to warrant going to the expense.

The dry goods establishment of Bernier & West, corner of St. Catharines and University streets, was recently damaged by fire to the extent of $30,000. The local press, as usual, announced that the fire was supposed to have been caused by electric wires. The report of the Fire Underwriters' Association, however, was that "there is no evidence to the effect that the fire was caused by electric wires; on the contrary, the fire seems to have started on the second flat in the vicinity of a sewing machine." The verdict of three experts, one of them perhaps the most capable man in the country on the question of electrical fires, was unanimous on the above point. If electrical firms would adopt some form of reprisal, say in the shape of cancelling advertisements, it might make certain newspapers who are so fond of ascribing fires to electricity without any proof, a little more careful.

## THE TORONTO ELECTRIC LIGHT COMPANY.

The Toronto Electric Light Co. are about to enter upon a number of extensive improvements for the purpose of extending and perfecting their service.

They have recently purchased a block of land adjoining the east side of their present property, having a frontage of 150 feet on the Esplanade and extending 1,064 feet southward to the wind mill line. It is the intention to erect immediately on this land a large machine and repair shop, and a little later on a new power station in which will be installed direct driven units of single phase alternators, of 750 kilowatt capacity each, of the Canadian General Electric Co.'s type, for incandescent lighting.

The present machine shops will be removed to allow of the extension of one of the present power stations to accommodate four more Heine boilers with a total capacity of 1,500 h. p., one vertical marine type compound engine of 1,500 h. p. capacity, and a single phase alternator of 500 kilowatt capacity.

The company have had plans and specifications prepared for a steel steamer of 600 tons capacity, to be used for bringing coal from American ports.

## LARGE ORDER FOR ELECTRICAL APPARATUS.

One of the largest and most interesting industries in Canada is that of the Dominion Iron & Steel Company, of Sydney, C.B. They purpose operating practically their entire plant electrically, and have just placed an order with the Canadian General Electric Company for a complete electrical outfit, consisting of: Three 500 kilowatt 250 volt direct driven generators; one 100 kilowatt Booster set, direct driven by motor; two 60 kilowatt single phase alternators, direct driven by motors, mounted on same base with alternators; three No. 12 125 light brush arc dynamos, direct driven by motors; 250 D. C. series enclosed arc lamps, and a complete equipment of marble panel switchboards and wiring supplies. This, together with an order for two 125 kilowatt direct connected units, recently placed with the same company, constitutes one of the largest orders ever given in Canada for electrical apparatus.

# TELEGRAPH and TELEPHONE

## THE COPENHAGEN "AUTOMATIC" TELEPHONE CALL BOXES.*

IN December, 1898, the Automatic Telephone Company, of Copenhagen, began erecting telephones on the "penny-in-the-slot" principle. At the present date there are about 465 instruments connected to the telephone exchange, and this number is being gradually increased. These telephones are placed in nearly all public buildings and theatres, and also in a number of houses where people live in flats. The test of about a year's use has shown that these instruments are thoroughly reliable. The inventors are Mr. L. M. Ericsson, of Stockholm, and the manager of the Danish company Mr. Sophus Ritter. Compared with the call-box instruments employed in this country, the chief advantages of this system are :

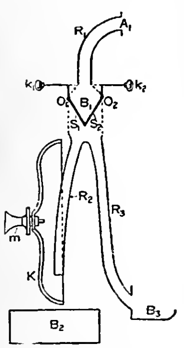


FIG. 1.

1. The exchange can only be called up after a coin (10 ore, about $2\frac{1}{2}$c.) has been dropped in; this prevents a deal of unnecessary trouble at the exchange.

2. In case the exchange cannot connect through, the coin is recovered by pressing a button.

3. Ringing off is avoided, as this is performed automatically by replacing the receiver on the hook.

4. By special arrangements for receiving extra coins, telegrams can be forwarded through the exchange.

Fig. 1 shows arrangement for receiving the coin. This is dropped in at $A_1$, and passes through the flat tube $R_1$ into the receptacle $B_1$. $S_1$ and $S_2$ are two forks, pivoted on $O_1$ and $O_2$ and insulated from one another. When a coin is resting in $B_1$ it connects $S_1$ and $S_2$, thus completing the circuit through the magnets I to the exchange (see Fig. 2), and the latter can now be rung up in the usual way.

After receiving the caller's demand and making the engaged test, the operator at the exchange answers either "Connected" or "Engaged." In the first event the caller pushes the button $k_1$ and the coin drops through the passage $R_2$, strikes the gong K, and falls into $B_2$. The operator at the exchange hears the coin strike against the gong, and only then connects through. If the reply "Engaged" has been received, the button $k_2$ is pressed and the coin is returned through the passage $R_3$ into the box $B_3$ placed on the outside of the telephone, whence the caller can recover it.

The connections are shown in Fig. 2. When not in use the receiver hangs on the hook N, and contact is made between $a_2$ and $a_3$. The one pole of the magnets I is in direct connection with the line $L_1$, while the other line, $L_2$, is broken beeween $S_1$ and $S_2$. After a coin has been dropped in, the circuit through the magnets is completed through $O_1$ $S_1$, the coin $S_2$ $O_2$ $a_1$ N$a_2$, and $a_3$ to line $L_2$, and the exchange can be called in the usual way. On taking the receiver off the hook N the circuit is broken between $a_2$ and $a_3$, and contact is made between $a_4$ and $a_5$, and the connections are the same as in a usual telephone.

When the receiver is replaced on the hook the line $L_2$ is connected through $a_4$ and $a_5$ to earth, and the clearing signal is given automatically at the exchange ; this is arranged on the "ringing through" principle.

Telegrams are telephoned to the operator at the exchange, and he telephones the amount to be paid. The necessary coins are then dropped through two slots at the right-hand top corner of the instrument ; on their way they strike against gongs, by means of which the operator can control the amount paid in.

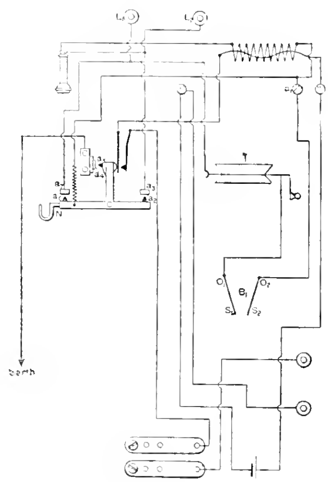


FIG. 2

The apparatus is mounted in oak cases, and on the outside of these are illustrated instructions for the public.

*From the Electrician, London.

## AMERICAN TELEPHONE PRACTICE.

THE above is the title of a very valuable work just issued by the American Electrician Company, 120 Liberty street, New York. The author, Mr. Kempster B. Miller, M.E., is recognized as an authority on telephone matters, and has presented in a concise manner the general principles of telephony, the design and construction of commercial apparatus, the circuits connecting such apparatus into operative systems, and the methods used in the construction, operation and maintainance of these systems. The book contains 458 pages, divided into 33 chapters and containing 357 illustrations. The subjects treated include : History and Principles of the Magnetic Telephone ; The Telephone Receiver ; Transmitters ; Batteries ; Commercial Calling Apparatus ; Self-Restoring Switch-board Drops; Transfer Systems ; House Systems ; Distributing Boards ; Overhead and Underground Cable Construction, etc.

The Dominion government has decided to proceedat once with the construction of the telephone line from Atlin to Quesnelle, to connect with the eastern telegraph system, so that messages can be sent direct by wire to Dawson. Mr. J. B. Charleston will have charge of the work.

The Bell Telephone Company have recently made improvements in their exchange at Acton, Ont., having installed a new combined local and long distance switchboard and made other improvements. The work was executed by Messrs H. E. Fairbank and Joseph Curzon. The local manager is Mr. A. T. Brown.

# ENGINEERING and MECHANICS

## ICE, NATURAL AND ARTIFICIAL, AND REFRIGERATING MACHINES.*

By E. J. Philip.

Ice is the solid crystalline form which water assumes when exposed to a sufficiently low temperature. Natural ice assumes different forms, such as hoar frost, snow, hail, and as we usually see and recognize it in sheets of ice on our rivers and lakes. Natural ice is also to be seen on a gigantic scale in glaciers and icebergs far north. To give an idea of the gigantic scale in which nature works in the matter of ice-making, an iceberg observed by Sir John Ross and Lieut. Peary was 2½ miles long, 2 1/5 miles broad, and 153 feet high. The mass above water was apparently 150 million tons, and the total mass, calculated from what appeared above the water, must have been 1,500 million tons, and this was not an unusually large berg. You will see by this that nature does what we cannot do.

I will give a short description of the manner in which ice forms and show the wise provision of Providence in connection therewith. As the temperature of the air falls the surface water in a lake or river gradually cools; as it cools it becomes heavier and sinks, due to the laws of expansion and contraction. The warmer water takes its place and is in turn cooled and sinks. This process goes on until all the water in the lake reaches a temperature of 4° C. or 39.1° F. At this point water has reached its maximum density; if its temperature continues to fall it will expand. In cooling from 4° C. to zero, the surface water cools first, expands, and remains on top. This is surely a wise provision of Providence, for if it was not for this exception to an almost universal rule, all our rivers and lakes would freeze at the bottom first and the accumulated heat of summer would never thaw it out, because it would only melt a little on top, and then, as it got warmer, it would expand and remain there and convection could not take place in heating as it does in cooling from the top. Convection can only take place in heating by applying the heat at the bottom. If the water froze at the bottom we would have no fish, or in fact any life on this planet, as the large bodies of water have a great deal to do with life on earth.

There is one feature about melting ice that should be thoroughly understood, and that is the fact that if you take ice at a temperature of say zero, chop it up, take it into a room and let it melt, you will observe, if you place a thermometer in the ice and watch it, that it will rise from zero or whatever it was at until it reaches the freezing point 0 C. or 32 F., and at this point the temperature will stop rising, no matter what heat be around the vessel. This is why the freezing point of water is easily fixed, as it remains there at that temperature until all the ice is melted. Ice by itself behaves as solids do, expands by heat and contracts when cooled.

Ice will melt at a slightly different temperature if subjected to pressure, as shown by Thompson & Helmholtz, but it is only the fraction of a degree, so it does not affect any operation that we are connected with. In the upper provinces of India water is frozen on cold clear nights by putting it out in porous vessels, or in bottles wrapped in wet cloths. The water in these cases freezes by virtue of the cold produced by its own evaporation (or by the drying of the moistened wrapper). In Bengal the natives have a more elaborate scheme for forcing or aiding the natural conditions—pits are dug about two feet deep and filled three-quarters full of dry straw, on which are set flat porous pans containing the water to be frozen. Exposed to a cool dry gentle wind, the water evaporates at the expense of its own heat and cooling takes place with sufficient rapidity to overbalance the influx of heat from above through the cool dry air, or from below through the dry non-conducting straw. These are only aids to nature, and in this country where we can store ice they are unnecessary. Freezing mixtures, such as the familiar salt and snow, sulphate or phosphate of sodium, and dilute nitric acid, have been used to produce an intense cold, but I will pass over these, as they have no relation to this article or to practical refrigeration to-day.

The demand for ice for domestic, medicinal and other purposes has led not only to the development of an organized ice trade, but to the invention of machines for ice-making and for the more economical refrigeration of rooms or buildings than can be done with ice no matter how cheap it can be obtained. These machines are of the greatest value to countries where there is no natural supply of ice, but they have advantages over ice in the cooling of rooms for storage that are of as great benefit as the cooling effect itself. All ice machines of any practical value can be grouped under two heads, viz., those that utilize the lowering of temperature that follows the rapid expansion of a compressed gas, and those that make use of a like cooling effect that results from the volatilization of some liquid. In machines of the first type the gas usually employed is atmospheric air, which is first compressed to three or four atmospheres, and then cooled by circulating water or other means. It is then allowed to expand, and the heat necessarily absorbed during expansion is drawn either from the water to be frozen or from brine that does not freeze at ordinary freezing temperature and thus becomes a vehicle for storing or conveying the cold, so to speak. In 1849 Gorrie constructed such a machine, but it was unsatisfactory, principally because of not cooling and drying the air properly. Kirk's machine, patented in 1863, and Windhaussen's in 1870, were more efficient. Windhaussen exhibited one at Vienna Exposition that produced 30 cwts. of ice per H. P. at a cost of 20 cents per cwt. The mode of operation of this machine is as follows: The air is compressed in one end of a cylinder, then cooled, passes to the other end of the cylinder, and is admitted for a portion of the stroke; the supply then being cut off and the air expanded during the rest of the stroke; this reduces it to a low temperature. Part of this cold air is used for cooling purposes, and another portion of it is used for cooling the heated air after expansion. The air that passed to the refrigerrtor is forced on by more air coming in; and after passing over the course is forced back to the compressor side of the piston, still comparatively cool, where it is again compressed, cooled, expanded, and the circulation kept up continually. Such machines to work economically must have large cylinders with tight fitting pistons working with little friction, easy and perfect working valves. These conditions are a most impossible to obtain or maintain, consequently they are almost a failure. Another of this kind of machine was invented in Glasgow, using as the cooling agent the gas distilled from carbonaceus shale. The gas was compressed to 120 lbs., and after cooling and expanding was carried off and used as fuel. This machine is not used for the production of ice but for refrigeration, and has been used successfully on board ship (recompressing the gas, of course) for preserving meats, etc.

Among the machines of the second class there is a great variety of construction because of the difference in the property of the liquids used, viz., water, sulphuric ether, bi-sulphate of carbon, ammonia, methylic ether, sulphuric acid, and even other substances have been employed as refrigerating agents. In all cases it is the latent heat of vaporization that is utilized, and did the efficiency of the method depend only on this, water would undoubtedly be the best material on account of the great latent heat of its vapor; but as important as this is the pressure and temperature at which the liquid boils. As early as 1755 Dr. Cullen froze water by its own evaporation in a vacuum. This method was developed by others, but can only be used for producing small quantities of ice and has no practical value. The same objection applies to sulphuric ether, bi-sulphate of carbon or any substance which boils under ordinary atmospheric pressure at temperatures above the air. Ether boils at 34.8° C., bi-sulphate of carbon at 46.2° C., and their vapor pressures are respectively .377 and .267 of an atmosphere. They volatize more readily than water and require a comparatively slight vacuum to render their evaporation sufficiently rapid for refrigerating purposes. Naphtha, gasolene and chymogene have been used in place of ether, but ether is the best, while having the objection that it is hard to prevent leakage, consequently it is hard to maintain a vacuum. It has also the tendency to change itself into less volatile vapors. The great characteristic of ice machines that employ ammonia, methylic, ether or sulphuric acid, as compared with those of the ether type, is the fact that they work at increased instead of diminished pressures, since these substances are gaseous at ordinary temperatures and pressures, and require for the liquefaction either the production of low temperatures or the application of high pressures. I might just state here that the boiling point of ammonia is 38.5° C., its vapor pressure as taken from a table at 10° is 6.1 atmospheres, at 20° 8.5 atmospheres, and at 30° 11.6 atmospheres. The boiling point of methylic ethers is 23.65° C., and its pressure in atmospheres at the same temperatures as given for ammonia is 3.5, 4.8 and 6.5. Sulphuric acid boils at 10.68° C., and its pressure in atmospheres is 2.3, 3.2 and 4.5 at the respective temperatures of 10°, 20° and 30°. You can see by these figures at once the reason or cause of the refrigerating action of these liquids?

The ammonia machine is the best known in this city, and, in fact, many do not know that there are other agents that can be used in place of ammonia. I will now try to make the action of mechanical refrigeration plain to you. We know that if we heat a liquid until it evaporates, it will absorb a quantity of heat that is not accounted for by the thermometer; that is, latent heat. We know if we suddenly reduce the pressure on boiling water that is under high pressure it will turn into steam. This latent heat evaporates it. Now, if we can get a liquid at low temperature that will evaporate into a gas at ordinary temperature, all we have to do is to compress it. That will give it a pressure, thereby increasing the boiling point; then if we cool this by the application of water we have a liquid at a lower temperature than is due to its pressure. If we now reduce the pressure we will reduce the temperature at which the liquid will boil, consequently it will boil on the reduction of pressure. Now, to boil, it must have heat just as water has, but as no heat is applied it must take up heat from surrounding objects. This is mechanical refrigeration. In the ammonia machine the gas is compressed thereby, raising its pressure and temperature. This gas passes from the compressor to a set of pipes over which cold water is running; this cools the gas and liquefies it or a portion of it. If it is then allowed to expand from high pressure to a low pressure, it will in expanding evaporate, and in evaporating it will take up heat from whatever surrounds the pipes containing it, that is, the air, thereby cooling the room. If the pipes are surrounded by water it will freeze; if by brine it will cool it down, and this brine can be pumped to any

*Abstract of a paper read before Toronto No. 1 C. A. S. E.

part of the building where it is not suitable or safe to use direct expansion of ammonia for cooling, and the brine will do the cooling instead. After the ammonia has expanded and evaporated to a gas it is returned to the compressor carrying the heat it picked up during expansion, and the compressor squeezes the heat out of it, so to speak, or makes it show, and it goes on through this cycle continuously. This system is known as the compression system, and the cycle of compression, condensation and expansion as explained before embodies the whole principle.

There is another system, known as the absorption system. This system I will not go into to-night. I have tried to make these few remarks as simple as possible, and to use no technical terms other than what anyone can understand. I have not touched on the application of refrigerating, which would take up a paper in itself.

## BOILER FEED WATER.*

By J. M. Williams.

This subject, one especially interesting and very important to all users of steam plants, will be treated under four heads: Water in the abstract; Water as we find it; Water for the boiler; Water in the boiler.

At the commencement of this survey of the subject in hand, among the items to be borne in mind is the axiom "matter is indestructible." It will appear later on how this idea applies to the subject. Illustrating this, your attention is directed to what occurs when a match is struck, the friction rubs off the coating which protects the phosphorus with which the sulphur is tipped and warms the phosphorus up to the igniting point; it bursts into flame and ignites the sulphur; it in turn sets fire to the wooden splint, and it, as you see, burns first to charcoal, and it in turn to ash. None of the material or the elements of the material are annihilated—they are still in the room and in their altered form and condition will form part of the atmosphere. Some will condense on the objects or walls of this room, some will be inhaled by us and be absorbed into our system or condensed on our clothes and be carried away with us, but not destroyed, not annihilated, only separated from the combination in which they existed as a perfect match and recombined as a trace of phosphorus acid, a trace of sulphuric acid and the same of carbonic acid, gases, and a little ash containing the silica, potash lime, etc.; we thus have all the material that formed the match, every atom still exists.

Water in the Abstract.—Water, the familiar fluid, is a chemical combination of two gases, hydrogen and oxygen; it may be made from these two gases and it may be resolved again into its original elements. This may be done by electric force or chemical action or by heat. These dissimilar disintegrating forces will make and unmake water. The apparatus which is used to illustrate the electrical decomposition of water will demonstrate the proportion of its two elements; two glass tubes filled with water and inverted over two terminals from a battery will be slowly filled with gas displacing the water and one tube will be found to have twice the volume of gas of the other. This larger quantity will be found to be hydrogen, and this proportion will be maintained as long as the decomposition lasts; this proportion is that of volume. Two volumes of hydrogen combine with one volume of oxygen. The weight of these volumes is in the ratio of two to sixteen, and each unitor atom of oxygen weighs sixteen times as much as one unit or atom of hydrogen. In the chemical decomposition of water, such as the familiar one of forming acetylene gas from carbide of calcuim, the oxygen is taken up by the metallic element and the hydrogen set free, also in the case of adding water to metallic sodium or potassium.

Water as we find it.—This would naturally suggest the large reservoirs of the earth, oceans, seas, lakes, rivers, etc., and the supplies in the form of snow and rain. These different supplies of water vary between the two extremes of pure and heavily charged with salt. Some lake waters are chemically pure, and the extreme is reached in the Dead Sea, where we find the water simply loaded with salt. Water is recognized as the universal solvent—it will dissolve to a greater or less extent nearly everything. The familiarity of this calls for little illustration, but it may be mentioned that solids, liquids and gases are dissolved by it. One example will be well recognized in the case of dissolved gas, that of soda water.

Water for the Boiler brings us to the particular features of the water supplies above mentioned. It will be accepted that water for the boiler should be clean, it also should be free from avoidable contaminations of injurious nature. The water supply will be of such a quality as the composition of the soil and the nature of the deposits in the locality, and any chemical refuse must be prevented if possible from getting into the supply. It will be found that in some cases the soil yields much matter to the stream flowing over it, and it occurs that water contaminated in one locality will be freed from its dissolved material by passing through a locality having a different composition of soil. In iron districts water will often be found freed from those elements which are destructive to boilers, the metallic deposits having taken up those elements. Some of the substances which are thus found in water supplies are there because of the decomposition of the material forming the water course by the action of the water itself; in other cases it occurs that the district is of volcanic origin, or it may be the remains of ancient ocean beds, or the accumulations of large deposits of organic matter, bogs, marshes, etc. We may here consider the nature of the substances which we find in water supplies. The usual ones are chlorides, sulphates, carbonates and nitrates, the elements so combined being calcium lime, magnesium, sodium, potassium, ammonium. Metallic compounds also in particular localities will include some of the heavy metals, such as lead, copper, etc. These, like the above, are carriers of injurious elements and are not dangerous excepting from forming deposits in the boiler. Another form in which water receives substances which may have bad effects is in gaseous condition in the air; from this source ammonia will carry into water chlorine and sulphur. Carbonic acid gas and even free nitric acid are substances which are features of the atmosphere, and to a greater or less extent injurious constituents of a water supply.

Referring to volcanic deposits having a tendency to affect the water in their neighborhood, it may be mentioned that so acid are some streams from the sulphuric acid formed from the sulphur that the copper sheeting of vessels is cleaned of oxide and the copper made bright by the solvent action of the acid in the water, and in certain rivers of this continent it is estimated that thousands of tons of sulphuric acid pass annually into the sea, and it is noted as a fact that in the civil war in America, the telegraph batteries of certain localities depended on vitriolic streams for their acid.

Water in the Boiler.—This part of the subject brings altered conditions. Water in its ordinary state has a temperature of about 40 to 50 degrees F., and the solvent quantity differs according to temperature. In many instances water will dissolve more when hot than cold, but conversely the earthy salts usually formed in water supplies are precipitated mainly because these salts are held in solution by carbonic acid gas, and this with other gases is much more soluble in cold water than warm, and is dissipated from hot water, with the result of the throwing out of solution of the earthy salt. This, together with the evaporation of water leaving the solids behind in making stream, is the cause of scale and boiler mud.

Not only is the mud left behind, but the elements which form the chlorides, sulphates, etc., remain also, and these, under the influence of the high temperature in the presence of moisture, decompose with the liberation of the radicle or acid part of the substance, which is then free to act on the iron plates or tubes, which it does to the sorrow of many a boiler owner. It will be recalled that the permanency of water was referred to at the beginning of this paper. We here meet with the system which operates when matter is subjected to altered conditions, if the alteration is considerable, to the extent which we have observed to occur in the boiler; then the combinations which previously existed will be broken up and other combinations will occur—calling to mind the match—and the metal of the boiler is called on to take its part in forming these combinations. A water containing chlorides is fed into a boiler and concentrated by the loss by evaporation into steam of the water. This concentration brings with it the breaking up of the chlorides. Carbonic acid gas being present, free and also combined, is liberated by the decomposing effect of high temperature as referred to already, and by that law which governs matter and which couples atoms, to themselves if nothing else is available; this carbonic acid gas displaces the chlorine combined as chlorides, and this in turn seeking to obey this law of combination, unites itself to its heat affinity, the iron of the boiler plate.

It will here be concluded that the chlorine having done its best or worst is out of the game, but no, chloride of iron is not more stable than chloride of calcium, magnesium, potassium, sodium or any chlorides which may pass into the boiler in the feed water. Chloride of iron will take up oxygen, which as atmospheric air is taken into the boiler, dissolved in the water, and if this were not there the water would be called on to furnish oxygen and an oxychloride formed passing on into a further addition of oxygen, and the formation of an insoluble oxide of iron and the chlorine is again on its cruel mission after an atom of iron, and so goes on moment after moment to a misroscopical extent, it is true, but like the coral insect, a little at a time if carried on long enough will accomplish much. As with the chlorine, so with the other salts; just the exact changes and processes it is not presumed to define, but the foregoing will throw light on the cause of the corrosion of boilers. Having surveyed to a limited extent the origin of scale and the cause of corrosion, we will consider the action of boiler purges. We have observed the liberation of corrosive acid elements, and to neutalize these most purges are alkalies, and remembering the decompositions just referred to, we can see that if these neutralized acids now in the form of salt, generally a soda, are allowed to remain in the boiler, we can expect to experience similar results again, calling apparently for more alkali, but the precautions which will best combat these dangers are emptying the the boiler, washing out and filling with fresh water. This has its limit, however, and must of necessity be controlled by fuel, time and circumstances, but it can be seen how valuable is blowing off—which only deducts from the contents of corrosive matter in the ratio of what is blown off—and more especially cleaning out.

[Two samples of boiler feed water were shown, one from a supply tank which showed presence of sulphuric acid and which had been complained of as being continually corroding. The other sample showed chlorides, both samples indicated by tests presence of free acids. The action of phosphate purge was also illustrated in conjunction with lime and magnesia, showing precipitation of the same.]

*Paper by J. W. Williams, of J. Winer & Co., chemists, Hamilton, read before Hamilton No. 2, C.A.S.E.

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At the regular meeting of Toronto No. 1, Canadian Association of Stationary Engineers, held on the second Wednesday in January, there was a good attendance of members. A paper relating to ice making and refrigerating machines was read by Mr. E. J. Philip, chief engineer of the T. Eaton Co. This paper, which is printed in this issue, created considerable discussion, and many questions were asked and explained. It has been arranged to hold an "At Home" in the large assembly hall of the Confederation Life Building on Wednesday, February 14th. The tickets are $1.

# ELECTRIC RAILWAY DEPARTMENT.

## CANADIAN STREET RAILWAY SYSTEMS.

During the past month several of the largest street railway companies in Canada have held their annual meetings. The statements presented, as outlined below, show that generally the business of the year was of satisfactory character.

HAMILTON, GRIMSBY & BEAMSVILLE ELECTRIC RAILWAY.

The annual meeting of the shareholders of the Hamilton, Grimsby & Beamsville Electric Railway Company was held in the city of Hamilton on January 22nd. Mr. A.J. Nelles, manager and secretary, submitted the financial statement, which was evidently satisfactory, there having been an increase of $1,934.33 in the revenue over that of 1898. The revenue for 1899 was $44,670.75, and the disbursements amounted to $27,729.87, leaving $16,940.88 of a surplus. Of the surplus $4,250 was paid in interest on bonds, $2,152.24 interest on borrowed money, and $5,665 as dividends, quarterly at 1 1-4 per cent.; total, $12,067.24. The balance, $4,873.64, added to $2,950.11 brought forward from 1898, made a total surplus of $7,823.75. The assets were given as $277,474.38. The liabilities were :—To the public $128,702.21, to the shareholders $113,300 capital stock, and $35,472.17 profit and loss account. A by-law was passed for the issuance of $35,472.17 of stock to paid-up shareholders, pro rata, this being 33 1-3 per cent. of the capital stock, $113,300. Officers and directors were elected as follows: C. J. Myles, president; W.J. Harris, vice-president; R.S. Martin, treasurer; L. Bauer, A.H. Myles, Robert Ramsay, R.S. Morris, directors. Mr. Morris was elected in place of John Gage, sen., who retired. Mr. A. J. Nelles was re-appointed manager and secretary.

LONDON STREET RAILWAY.

The twenty-fifth annual meeting of the London Street Railway Company was held at the company's offices in London. The annual report, which was read by Mr. C.E.A. Carr, secretary treasurer, showed a falling off in gross revenue, as compared with the previous year, of $53,864.19, and the working expenses exceeded the receipts by $6,928.54. This was due to a strike of employees which commenced on May 22nd and continued for several months. The gross revenue for the year was $59,947.58, as against $113,811.75 for the previous year. The operating expenses were $66,872.10, an increase over the previous year of 1.8 per cent. The quarterly earning statement showed that the revenue increased during the first quarter of the year, when there was no strike, 10.2 per cent., so that had the system remained in operation without interruption a most satisfactory year would likely have been the result.

The old board of directors was re-elected: Mr. Everett, president; Mr. Smallman, vice-president; Mr. Carr, general manager and secretary-treasurer, and Messrs. Moore, Wasson, Spencer and Broderick, directors.

OTTAWA ELECTRIC STREET RAILWAY.

The Ottawa Electric Railway Co. experienced the most successful year in its business history. The statement presented at the annual meeting showed that the total number of passengers carried was 5,833,829, an increase of 700,000 over the previous year. The net profit was $85,280.37. Four quarterly dividends were paid, amounting to $65,184, and the sum of $20,093.37 was carried forward to the credit of profit and loss. The gross earnings for the year were $263,545.05, as compared with $231,806.02 in the preceding year. A duplicate plant was installed during the year, consisting of a set of horizontal water wheels of a capacity of 1,800 h.p., directly connected to a generator of similar capacity. The Britannia extension is expected to be in operation by May 1st.

The following were elected directors: Messrs. T. Ahearn, J. W. McRae, George P. Brophy, Warren Y. Soper, Peter Whelan, Thomas Workman and Alex. Lumsden, M.P.P. At a subsequent meeting of the board Mr. Thos. Ahearn was elected president, Mr. J. W. McRae vice-president, and Mr. James D. Fraser, secretary-treasurer. Mr. Redmond Quain was appointed auditor.

TORONTO STREET RAILWAY.

The eighth annual meeting of the Toronto Street Railway Co. was held on Wednesday, January 17th. The report of the year showed a net profit of $432,869.43, compared with $404,738.80 for the previous year. Out of this amount, after paying dividends of $240,000, and deducting pavement charges paid to the city, the sum of $12,869.43 is left to carry forward. The gross earnings during the year were $1,333,542.44, an increase of $122,924.20 over the preceding year.

The operating expenses were increased by 1.4 per cent as compared with those of 1898, this being ascribed chiefly to a general advance in the cost of materials. A capital expenditure of $240,000 was made for an engine, generator, boiler, rolling stock, feed wires and car sheds. During the year 80 cars and two electric sweepers were added to the rolling stock. Two car sheds, capable of storing 100 cars, and a brass foundry were built.

During the year the company paid to the city the following amounts: Percentage on earnings, $111,425.66; pavement charges, $64,000; taxes on rails, poles and wires, $2,641.12 and on real estate $$9,365.85, or a total of $187,432.63. In addition there was also paid the provincial tax, amounting to $4,748.21.

As shown by the financial statement, the assets of the company total $10,263,615.27, made up as follows: Road and equipment, real estate and buildings, including pavements and suburban lines, $10,089,953.01; stores in hand, $30,874.87; accounts receivable, $19,764.63; cash in bank, $106,210.84, and cash in hand, $16,811.92. The liabilities are: Capital, $6,000,000; bonds already issued, $2,999,953.33; and incidentals, which, with nearly $1,000,000 carried to profit and loss, bring the total to $10,263,615.27.

A comparative statement of the last four years is as follows:

Gross earnings—1896, $997,273.20; 1897, $1,077,612.53; 1898, $1,210,618.24; 1899, $1,333,542.44.

Operating expenses — 1896, $507,760.31; 1897, $525,801.25; 1898, $578,857.26; 1899, $650,324.55.

Net earnings—1896, $489,512.67; 1897, $551,811.28; 1898, $631,760.98; 1899, $683,217.89.

Passengers carried—1896, 23,537,911; 1897, 25,271,314; 1898, 28,710,388; 1899, 31,826,940.

Transfers—1896, 7,354,895; 1897, 8,160,022; 1898, 8,287,239; 1899, 10,538,279.

Percentage of operating expenses to earnings—1896, 50.9; 1897, 48.8; 1898, 47.4; 1899, 48.8.

## SPARKS.

An agitation has been commenced to have the village of Granton, Ont., lighted by electricity from the power house in the village of Lucan.

The St. Catharines Cold Storage Co., Ltd., have ordered a 20 horse power 500 volt multipolar motor from the Canadian General Electric Company.

Residents of Crediton, Ont., are said to be looking into the question of profitable investment in an electric light plant for street and commercial purposes.

The Canadian General Electric Company are installing several of their two phase induction motors at the works of the Hamilton Bridge Works, Hamilton, Ont.

The Slade Electric Company, of Quebec, has secured the contract for electric wiring of the Franciscan church, sacristy and presbytery on Grande Allee, in Quebec city. Nearly 1,000 lights will be required.

The authorities of Winnipeg general hospital are installing an electric lighting plant, and have placed an order with the Canadian General Electric Company for one of their standard direct current 60 kilowatt generators of the multipolar type.

Application will be made to the Dominion Parliament for an act to permit the Buffalo Railway Co. to acquire the assets and franchise of the Niagara Falls Park & River Railway Co., the Clifton Suspension Bridge Co., the Queenston Heights Suspension Bridge Co., and the Queenston Heights Bridge Co.

The Pratt & Letchworth Co., of Buffalo, who are about to open a Canadian factory for the manufacture of steel castings, etc., at Brantford, Ont., have placed their order for electrical equipment with the Royal Electric Co. This order includes one 40 h.p. and two 15 h.p. S.K.C. induction motors, with transformers and condensers.

Mr. F. B. Brothers, well known in street railway circles, returned to Montreal from Demarara last month. Mr. Brothers is now manager of the Demarara Electric Co., Limited, and his mission is to purchase equipment for the trolley system to be built at Georgetown, British West Indies, by Montreal capitalists. He states that about 15 miles of track will be laid down in the city and that considerable extensions will be made later on.

The South African Mutual Life Insurance Co., of Port Elizabeth, Cape Colony, has awarded the contract for a complete electric light plant to the Royal Electric Co., of Montreal, Canada. This plant consists of two 50 h.p. locomotive boilers two 8 x 10 high speed engines, direct connected to two 22½ k.w. direct current generators, a marble switchboard and a set of storage batteries, the whole to be installed in the South African Mutual Life Insurance Co.'s new premises at Port Elizabeth.

The shareholders of the Toronto & Suburban Railway Co. held their last annual meeting at Toronto Junction on January 24th, at which the following directors were elected: Frank Turner, C.E., R. Wilson Smith, Robert B. Henderson, Allan Boyce, sr., E. P. Heaton and R. L. McCormack. At a subsequent meeting of the directors, Frank Turner was elected president and E. P. Heaton vice-president. It was decided to look into the advisability of extending the road further into the county.

The third annual session of the International Mining Congress will assemble in the city of Milwaukee, Wis., on Thursday, June 19th, 1900, and continue for five days. It is expected that this congress will be of great importance in promoting the interests of the mining industry. Large committees have been appointed, and visitors will be given every attention. Information regarding the congress will be cheerfully furnished by Mr. T. J. Sullivan, secretary of the local executive committee, Sentinel Building, Milwaukee.

The annual meetings of the Hamilton Radial Railway, Hamilton Street Railway, and Hamilton and Dundas Railway, three corporations controlled by the Cataract Power Company, were held on January 15th, when the following officers were elected: Radial Railway Company—John Patterson, president; Hon. J. M. Gibson, vice-president; J. Moodie, treasurer. Hamilton Street Railway Company—Hon. J. M. Gibson, president; John Dickenson, vice-president; John Patterson, secretary; John Moodie, treasurer. Hamilton and Dundas Railway Company—John Dickenson, president; J. A. Kammerer, vice-president; J. Patterson, secretary; John Moodie, treasurer.

At 11 o'clock on the night of Tuesday, January 9th, fire occurred in the power house of the St. Jerome Light & Power Co., St. Jerome Que., which totally destroyed their electric plant. On Wednesday afternoon at 3 o'clock the Royal Electric Co. was instructed by the St. Jerome Company to forward to them, as quickly as possible, a 75 k.w. S.K.C. generator, complete with exciter and switchboard. The entire outfit went forward that evening, was received in St. Jerome Thursday morning at 10 o'clock, the destroyed plant was removed, and the new one put in its place and the lights turned on as usual at 5 p.m. on Friday. Forty-eight hours after the receipt of the order by the Royal Electric Co. in Montreal lights were again burning in St. Jerome. This is quick work, and shows what can be accomplished by thoroughly wide-awake people.

## MOONLIGHT SCHEDULE FOR FEBRUARY.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H. M. | H. M. | H. M. |
| 1.... | P.M. 5.40 | A.M. 6.15 | 12.35 |
| 2.... | " 7.00 | " 6.15 | 11.15 |
| 3.... | " 8.00 | " 6.15 | 10.15 |
| 4.... | " 9.20 | " 6.15 | 8.55 |
| 5.... | " 10.30 | " 6.10 | 7.40 |
| 6.... | " 11.30 | " 6.10 | 6.40 |
| 8.... | A.M. 12.30 | " 6.10 | 5.40 |
| 9.... | " 1.30 | " 6.10 | 4.40 |
| 10.... | " 3.00 | " 6.00 | 3.00 |
| 11.... | " 3.30 | " 6.00 | 2.30 |
| 12.... | No Light. | No Light. | ..... |
| 13.... | No Light. | No Light. | ..... |
| 14.... | No Light. | No Light. | ..... |
| 15.... | P.M. 6.00 | P.M. 8.30 | 2.30 |
| 16.... | " 6.00 | " 9.30 | 3.30 |
| 17.... | " 6.00 | " 10.30 | 4.30 |
| 18.... | " 6.00 | " 11.20 | 5.20 |
| 19.... | " 6.00 | A.M. 12.00 | 6.00 |
| 20.... | " 6.00 | " 1.00 | 7.00 |
| 21.... | " 6.10 | " 2.00 | 7.50 |
| 22.... | " 6.10 | " 3.00 | 8.50 |
| 23.... | " 6.10 | " 4.00 | 9.50 |
| 24.... | " 6.10 | " 5.00 | 10.50 |
| 25.... | " 6.10 | " 5.40 | 11.30 |
| 26.... | " 6.10 | " 5.40 | 11.30 |
| 27.... | " 6.20 | " 5.40 | 11.20 |
| 28.... | " 6.20 | " 5.40 | 11.20 |
| | | Total......... | 185.00 |

## TRADE NOTES.

The Goldie & McCulloch Co., Limited, Galt, Ont., recently supplied a boiler for the Hamilton Steel & Iron Co., Hamilton.

Walter F. H. Massey has purchased from the United Electric Co., Toronto, a motor for operating fans at his Model farm.

Messrs. Lawry & Sons, pork packers, Hamilton, Ont., have added to their electrical equipment a 7 h.p. S.K.C. induction motor, purchased from the Royal Electric Co.

We are indebted to the National Carbon Co., of Cleveland, Ohio, for copies of their calendar for 1900, accompanying which is the moonlight schedule for the year.

At a meeting of belting manufacturers and dealers held in Montreal a fortnight ago an advance in prices was decided upon, due to the advanced cost of the raw material.

The Canadian General Electric Co. have received an order from the corporation of the town of Drummondville, P.Q., for one of their standard 45 kilowatt 500 volt multipolar generators.

The Toronto & Hamilton Electric Co., of Hamilton Ont., have recently removed to larger premises, in which they have installed considerable new machinery, which is driven by electricity.

The Calgary Water Power Co., of Calgary, N.W.T., has been compelled to increase its plant, and is installing a 150 k.w. S.K.C. two-phase inductor alternator, supplied by the Royal Electric Co., of Montreal.

The Gutta Percha Rubber Co. of Toronto are increasing their electric lighting plant, and have ordered another 50 kilowatt generator, direct connected to an Ideal engine, from the Canadian General Electric Company.

Messrs. Ahearn & Soper, of Ottawa, Canadian agents of the Westinghouse Electrical and Manufacturing Co., are sending out a very neat paper knife, which will be appreciated for its usefulness and serve well the purpose of an advertisement.

The attention of the electrical companies is directed to the advertisement of Mr. E. J. Brown, of Brantford, on the last page of cover of this number, in which he intimates that he is in a position to make repairs to all kinds of electrical apparatus on short notice.

The National Cycle & Automobile Co., who have recently commenced the manufacture of bicycles, automobiles, etc., in the city of Hamilton, intend operating their works by electricity, and have placed their order with the Royal Electric Co., of Montreal, for two 30 h.p. S.K.C. induction motors.

Messrs Collyer & Brock, electrical engineers and contractors, Montreal, are now engaged in installing 350 incandescent lights and 18 telephones in the residence of Hon. G. T. Fulford at Brockville, Ont. They have also been awarded the contract for fitting up electrically the Eastern Townships Bank at St. Hyacinthe, Que.

The Canadian General Electric Company have received an order from the Trenton Electric Company for one of their standard three-phase alternators, 250 kilowatt capacity, wound for 2,300 volts, together with switchboard, step up and step down transformers and distributing panels, for their sub-station at Belleville, Ont.

The gyrator system of flour milling, of which the Goldie & McCullough Co., Limited, Galt, Ont., are the sole Canadian makers, is meeting with much favor among millers. They have put this machinery in mills in nearly every province in the Dominion. Recently a car-load was shipped to the Farmers' Milling Co., Fort Saskatchewan, N.W.T.

The town council of Neepawa, Manitoba, in accepting the electric light and power plant recently installed by the Robb Engineering Co., passed the following resolution: "That this council have much pleasure in bearing testimony to the efficient manner in which J. F. Porter has installed the engine and boilers in connection with our electric plant, and that a copy of this resolution be sent to the Robb Engineering Co."

A completely equipped electrical supply house is that of Mr. John Forman, of Montreal, whose new quarters are at 708 and 10 Craig street. The building is four stories high, beside the basement, and is admirably lighted and fitted up. In the basement is found the heavy goods, such as cables, conduits, heavy wires, insulators, etc. Mr. Forman's private office is located on the second floor, together with a new laboratory equipped with various instruments for testing incandescent lamps. In this laboratory instruments may be tested by the public free of charge, a privilege which will no doubt be appreciated by users of electricity. The two upper stories will be devoted to manufacturing. Mr. Forman has purchased the plant of the Canadian Bryan Electric Co., and will manufacture a complete line of cut-outs, switches, rosettes, sockets, etc.

An ingenious arrangement to prevent overcrowding of stairways and elevators when entering or leaving a building is used in main office of the International Correspondence Schools, Scranton, Pa. The time of entering and leaving the building is regulated by clocks on each of the five floors. On the lower floors the clocks are set correctly, but on the upper floors they are a few minutes slow, so that the employees on the lower floors are at their desks before those on the upper floors are due at the building. In leaving the building the employees on the upper floors do not leave their desks until several minutes later than those on the lower floors. Over 500 people are employed in the building, which is used exclusively by the International Correspondence Schools. This institution has over 70 courses of instruction by mail and its students may be found in all parts of the world.

The United Electric Company, Toronto, report the following sales: The Tate Optical Co., Peterboro, a motor for operating their plant; Ritchie & Ramsey, New Toronto, a dynamo for lighting their works; Dodge Mfg. Co., Toronto Junction, Ont., dynamo for lighting their works; Hamilton Steamboat Co., dynamo for lighting the steamship Macassa; The E. S. Stephenson Co., St. John, N.B., several motors, among others two of 8 h.p., two of 6 h.p., and one of 2 h.p.; F. B. Allan, of Toronto, for the Nonsuch Mfg. Co., a 15 h.p. motor with which they intend to operate their manufacturing plant; Jas. Fenwick, Preston, a 75 light arc dynamo, with a number of lamps, for lighting the town of Preston; J. Forman, Montreal, a number of their standard type motors, including one of 6 h.p., and one of 8 h.p.; H. Phillips, Toronto, one of their 6h.p. standard type motors for operating his manufacturing plant. The United Electric Company have also just completed an installation for lighting the factories and yards of the Northumberland Paper & Electric Co., of Campbellford, Ont.

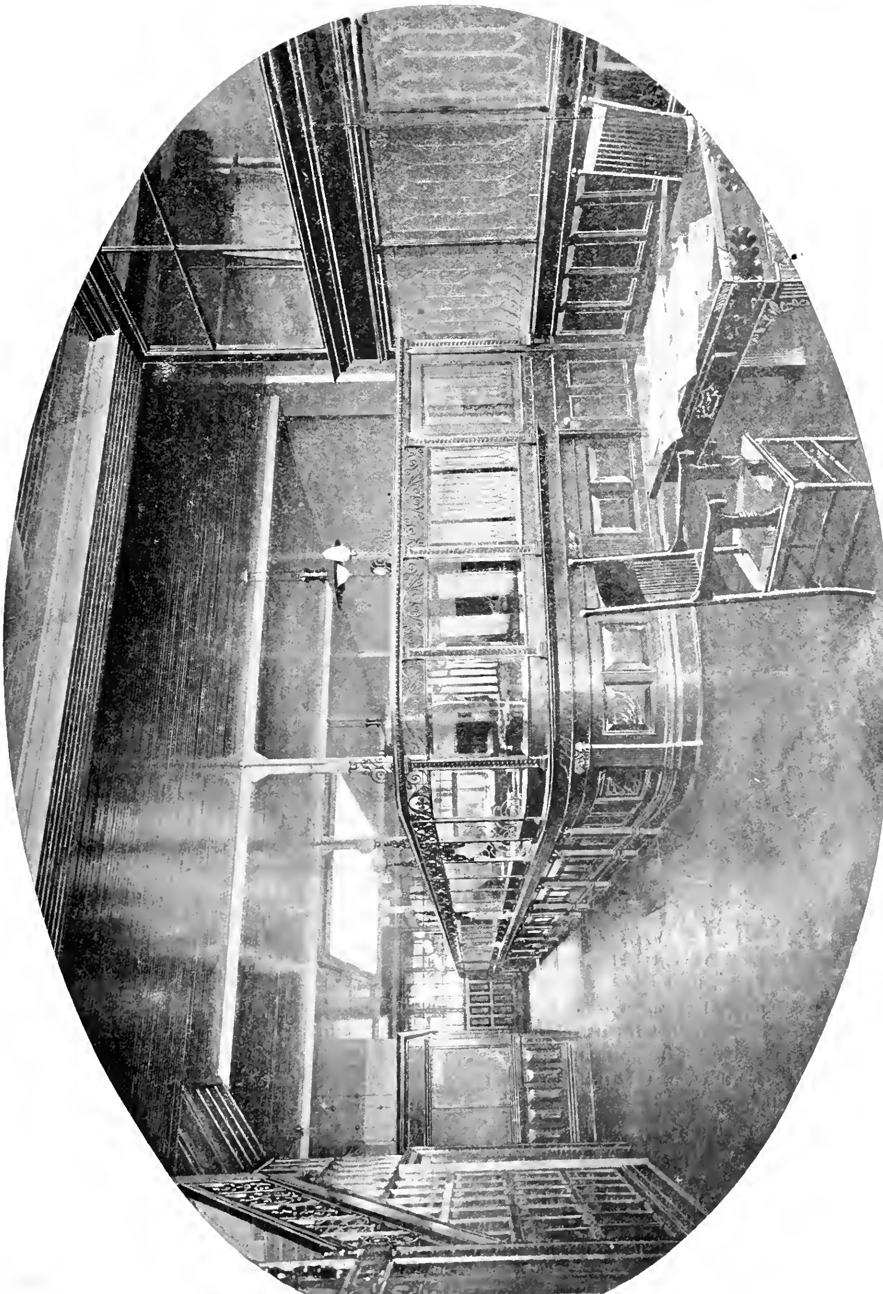
CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. X. MARCH, 1900 No. 3.



CANADIAN GENERAL ELECTRIC COMPANY, TORONTO—INTERIOR VIEW OF GENERAL OFFICES.

## NEW OFFICES OF THE CANADIAN GENERAL ELECTRIC COMPANY.

Owing to the rapidly increasing growth of their business, the Canadian General Electric Company last year found that the accommodation at their head office, 65 to 71 Front street west, Toronto, had become inadequate for their needs. They consequently leased the entire building, Nos. 14 and 16 King street east, and had it remodelled to suit their present requirements and also with a view to providing future accommodation. The alterations were completed about the first of September last, at which date removal to the new premises was commenced.

The new offices are conveniently situated in the centre of the business district of the city. The building is a four story one, with a total floor space of over 25,000 square feet. It is equipped throughout with modern facilities and a completeness of detail particularly suitable for enabling the company to meet the growing demand and better serve the wants of their customers throughout the Dominion.

On the ground floor are situated the general manager's office, board room, offices of the executive officials, and the general offices. A handsome suite of private offices has also been provided for the convenience of out-of-town customers, to whom the company extend an invitation to make use of them for business appointments, etc.

On the first floor is a nicely arranged show-room and a display of samples, representing a wide range of electric light, power and railway material, and general supplies, including switchboards, station and portable measuring instruments, motors, transformers, enclosed arc lamps, fan motors, electric cooking and heating appliances, and numerous other devices, many of which are shown in operation. Those who are directly or indirectly connected with the electrical industry will find a visit to this show room of much interest.

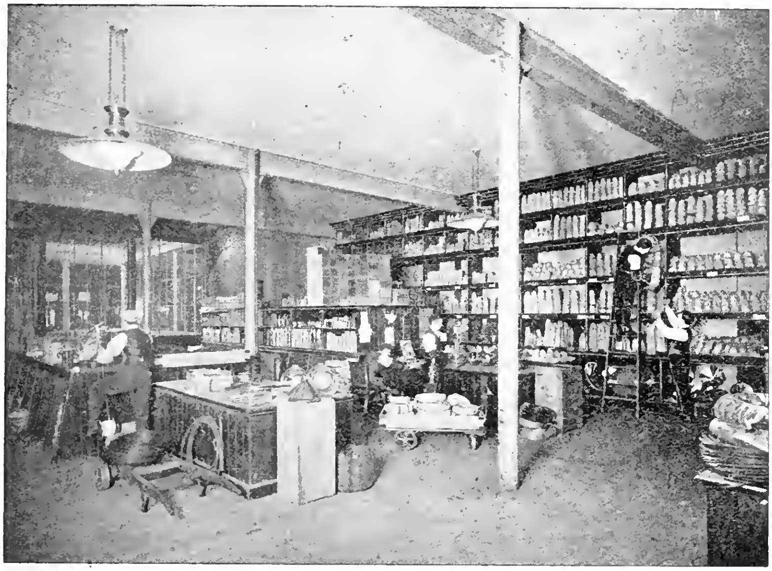
The warehouse is also located upon the first floor and includes the second floor and basement, with a total floor area of about 17,000 square feet. A large and well assorted stock of staple supplies and material is carried. Each floor of this department is connected by a private warehouse telephone system.

Canadian General Electric Company, Toronto.—General Manager's Office.

The entire third floor is occupied by the engineering department, and is laid out in general office, designing, drafting and testing departments.

All of the different departments and floors are rendered easy of access by means of an electric passenger elevator. Among other salient features of the establishment may be mentioned a local telephone system with a central office in the building, thus enabling every department to have direct communication with each other as well as to outside points. A long distance telephone and telegraph office (the Company having its private wire to the works at Peterboro') are also conveniently located in the general offices.

We might go on indefinitely dealing with the innumerable details which go to make up the many valuable appurtenances and conveniences of these offices.



CANADIAN GENERAL ELECTRIC COMPANY, TORONTO.—VIEW OF WAREHOUSE.

Mention might be made, however, of the fact that most of the building is lighted by C. G. E. 5-ampere direct current enclosed arc lamps. This system, which is generally conceded to be one of the best means of artificial lighting, is most satisfactory.

For the accompanying views, showing the general manager's office, general offices and warehouse, we are indebted to the Canadian General Electric Company.

## CENTRAL ONTARIO POWER COMPANY.

A CHARTER has been granted by the Ontario legislature to the Central Ontario Power Company, Limited, with a capital of $750,000. The objects of this company are to develop the Burleigh Falls water power, to carry on the business of an electric light, heat and power company in Peterboro', Lindsay, and vicinity; and, subject to provisions of the Street Railway Act, to construct an electric railway in the town of Peterboro', village of Ashburnham and townships of Smith and North Monaghan. The incorporators are: J. A. Culverwell, managing owner of the Burleigh Falls water power; Honourable Richard Harcourt; Eugene Coste, engineer; F. W, Barrett; Dr. Edward Adams, all of Toronto; Robert James McLaughlin, of Lindsay; James Kendry, Peterboro'; H. J. Taylor and H. E. Larkin, St. Catharines, and Honourable Peter McLaren, Perth.

The twenty-third annual convention of the National Electric Light Association of the United States will open in Chicago on the 22nd of May next.

Mr. W. J. Clark, of Toronto, has made application to the Ontario Legislature to construct an electric railway from Mine Centre to Dryden, Ont., and to acquire water powers along the proposed route.

The new electric light plant installed by the city of Winnipeg was put in operation a fortnight ago, and is sa to work satisfactorily. There are 212 arc lights, and the total cost of installing the system was in the neighborhood of $60,000.

Mr. James Ferguson, of New York, was recently in Vancouver forwarding a scheme to transmit electric power to that city from Slave river, 20 miles distant. It is said that a company has been formed and that $200,000 will be expended in installing a plant.

Power's Directory of the electric lighting central stations in the United States, Canada and Mexico continues to reach us every three months. The subscription price of this work is $4 per year, the publishers being E. L. Powers Company, 150 Nassau street, New York.

The Power Publishing Company, World building, New York, have sent us a copy of a recently issued monograph on "Condensers." It consists of a series of lectures and articles upon the subject reprinted from the columns of Power and contains, a vast amount of information. The price is 50 cents.

CANADIAN GENERAL ELECTRIC COMPANY, TORONTO—VIEW OF WAREHOUSE.

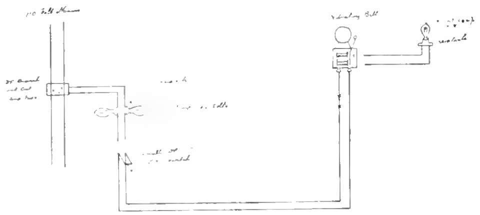
## PLAN OF ELECTRIC BELL SYSTEM.

MONTREAL, February 1st, 1900.

Editor Electrical News.

DEAR SIR, —Thinking that some of your subscribers may have occasion to use ordinary electric bells on an electric light circuit, I enclose sketch and herewith offer explanation of a plan found to work very satisfactorily.

By ordinary electric bells, I refer to those which are generally connected with 2 or 3 cells of open circuit battery. There are bells wound to operate, I believe, on 110 volts D.C., but same are not "common stock," and it means delay to procure them. Assuming, there-



PLAN OF ELECTRIC BELL SYSTEM.

fore, that we have a bell having coils whose resistance are from 4 to 7 ohms, and that the factory manager, having had trouble with batteries running down, and with small boys among the help "monkeying" with same, we will install as per sketch from the electric light circuit, D.C.

Explanation: We use 52 volt lamps simply so that if there is a bad ground one of the lamps will receive the full voltage and burn out, thus opening the line. The shunt lamp must be the standard voltage of the circuit, in this case 110. The only thing requiring any experiment is this shunt lamp; possibly an 8 or 10 c.p. may be found to act better than 16 c.p. The shunt lamp is connected to the pivot supporting the armature and to the pillar supporting contact screw back of armature, the object of this shunt lamp being to act as a condenser and absorb the spark which would otherwise ruin the platinum contacts in time.

The switch (or button) being double-poled, the main part of the circuit is open unless just at such time as the bell is in operation. If more than one bell is desired to be rung, cut the wire at points shown x x and continue the circuit, using bells connected for single stroke. These S S bells will, of course, vibrate also in unision with the stroke of the vibrating bell which controls them.

No new principle is involved here, but I am not aware that it has been used thus, although I have seen bells rung by being put in series with one 16 c.p. lamp (on one wire), said lamp being of the standard voltage of the circuit. It is apparent in this style that the sparking of contacts has not been provided for, neither has any provision been made against a 'ground,' as is done in method here shown.

Trusting the above may be of use to some reader, and if acceptable I may give you later an arrangement of alternating current used with success.

Yours truly,

SUBSCRIBER.

N. B.—Use porcelain insulators and No. 14 electric light wire for installing.

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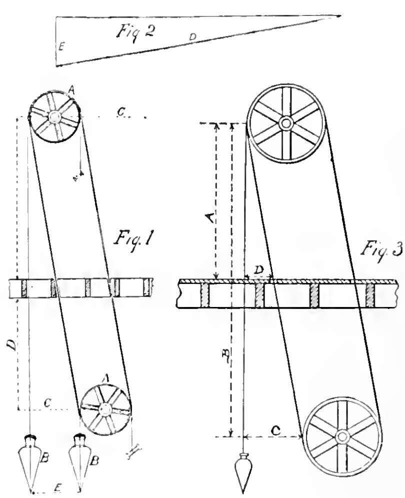
The corporation of Ottawa, Ont., desires tenders by March 13th for fire alarm supplies and coils.

## HOW TO CUT A BELT HOLE.

Correspondents to the American Miller have been telling how to find out just where to cut a belt hole in a floor. Fig. 1 shows one method, the advocate which says for it: A A represent the two pulleys. We will draw the line, with plumb-bob B attached, over the top pulley, allowing it to dot the floor, where we will bore a hole for the string to go through. We then allow the plumb-bob to swing clear of this hole and below the lower pulley. Then for accuracy we place a line over the face of the lower pulley, with a plumb-bob attached to it also. Now, to find the degree the two pulleys represent, we measure the distance between the points of the two plumb-bobs, on the line marked E. We then measure between lines C C representing the center of each shaft. By reducing these two measurements to quarters of an inch we find the degree of the bevel D, which is shown in Fig. 2. Set the bevel to this degree, place it on the floor where the hole is to be cut, and rest it on a level; place a straightedge on the face of the pulley, allowing one end of it to rest on the floor; bring it to the same pitch as your bevel and you have the center of the hole.

The one contributing the plan shown in Fig. 3 says: All we want is a man with a small auger, a plumb-bob and line, a saw, pencil and measuring tape. Let him plumb down from the face of the upper pulley, dot the floor, bore a hole and pass the plumb line through so it will swing clear from the upper pulley. Measure the distance from center of top pulley to floor, which is shown in the sketch as line A. Then measure from center of top pulley to line C, running through center of bottom pulley. Finally, measure the distance from plumb line to face of lower pulley, which measurement forms the C. Multiply A by C and divide the product by B, which will give the length of D. For example, distance A is 8 feet, distance B 12 feet, and distance C 20 inches. Then 8 times 20 equals 160, divided by 12 equals $13\frac{1}{3}$ inches, which is the distance from plumb line to edge of belt hole. Allowance must be made for belt and lacing. If the two pulleys are of the same size the second belt hole will go through the floor at a distance from the first belt hole equal to the diameter of the pulley. If the pulleys are of different sizes, the distance will be about equal to the sum of the diameters divided by 2. Bore small holes and stretch




CUTTING FLOOR HOLES FOR BELTS.

the plumb line over pulley faces to see if measurements are correct, and then saw in whichever direction the holes must go to give the belt plenty of room.

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The Canada Atlantic Railway Co. have inaugurated a system of electrical clocks at terminal points on their line. The clocks are run by storage batteries, and do not require winding. Time is taken from them all along the line at 11 o'clock a. m. each day.

The experts appointed to examine the applicants for the position of engineer of the new municipal building in Toronto have reported that in their opinion none of them reached the necessary standard, and it has been recommended that the council again advertise for applicants for the position. The salary is to be $1,250 per year.

## ELECTRIC LIGHTING AND POWER PLANT, VICTORIA HOSPITAL, LONDON, ONT.

One of the most modern and efficient equipments installed during last year was that of the Victoria Jubilee Hospital at London, Ontario. A rigid specification was prepared by the Gilbert Wilkes Engineering Company, of Detroit, under whose supervision the work was installed and tested.

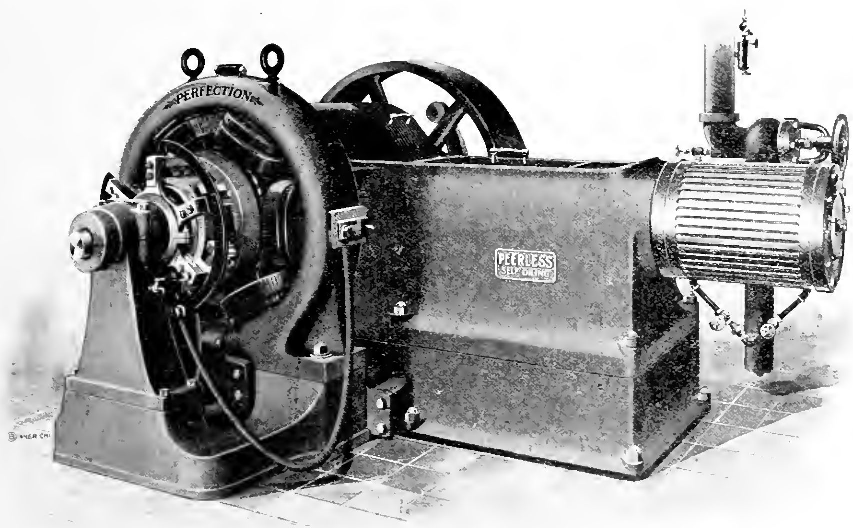
The plant, consisting of two direct connected engines and generators of 43 h.p and 32 k.w. capacity respectively, were to be of noiseless operation, to have a regulation within a two per cent. limit, and a capability of being over-loaded twenty-five per cent. for several hours without injury. The contract was secured by the Electrical Construction Company, of London, Limited, who have installed the entire plant without an objection being raised, and it has been in use now about five months, giving the very best of satisfaction.

Being a duplicate plant, it has been customary for the over-load and one-filth of full load, no adjustment of the brushes being necessary, nor was any special attention whatever required.

The engines, supplied by E. Leonard & Sons, also of London, are of their Peerless self-oiling type, and are lubricated automatically in all parts without attention. Renown engine oil is used for all bearings, and Capitol Renown for the cylinder.

The equipment is electrically controlled by means of a beautiful pink Tennesee marble switchboard, provided with Weston instruments, ten light circuit switches, five motor circuit switches, main switches, pilot lights, ground detectors and rhoestats, making a very compact and well arranged board.

The plant also furnishes power for two direct connected elevator equipments, installed by Messrs. Malloch & Co., of London, the electric motors and controllers of which were furnished by the Electrical Construction Company, of London, Ltd., who also installed two motors direct belted to fans, which are used to




Electric Lighting and Power Plant, Victoria Hospital, London, Ont.

engineer in charge to run each unit for twenty-four hours, as light and power are required continuously throughout the building. However, beginning with Saturday, 17th February, one of the generating sets was started on a seven day continuous (night and day) run, at the end of which temperatures were taken, showing the following remarkably low temperature rise of the different parts above the surrounding atmosphere :

Commutator, 11° centigrade.
Armature core, 17° centigrade.
Crank pin journal, 17° centigrade.
Lett bearing of engine, 13° centigrade.
Right bearing of engine, 11° centigrade.
Oil of engine, 16° centigrade.
Field coils of dynamo, 9° centigrade.

Considering that a limit is allowed in general engineering practice of 40° and sometimes 50° centigrade, the above figures are exceptionally satisfactory. During the week the load had varied between 10 per cent. exhaust air from the entire building. In all, the Victoria hospital is deservedly proud of its plant, which is entirely of London manufacture.

### THE GENERAL DEMAND FOR EDUCATION.

America has become the workshop of the world. Immense resources and economic methods of manufacture enable her to compete successfully with all other munufacturing countries in their own markets, and during the next few years the expansion of her trade will become the talk of the world.

The great impetus recently given to all technical trades and professions by the announcement of a new era of commercial prosperity, has forcibly brought to the attention of the public the great value of technicai education, acquired simultaneously with practical experience. The graduate of the ordinary technical university is obliged to accept a minor position in his profession, and trust to his education for rapid advancement. But the ambitious mechanic can make immediate application of his technical knowledge and secure, in the shortest possible time, a lucrative position.

The various engineering colleges are open to but few. Night schools are only found in the larger cities. The Internationa system of instruction by correspondence fully meets the requirements of ninety-five per cent. of the people, by supplying the education for which employers are willing to pay, and pay well.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBISHING CO'Y
of Toronto, Limited,

OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.

NEW YORK LIFE INSURANCE BUILDING, MONTREAL.
Bell Telephone 2299.

***ADVERTISEMENTS.***

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

***SUBSCRIPTIONS.***

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advaoce. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the anadian Electrical Association.**

## CANADIAN ELECTRICAL ASSOCIATION.

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B. F. REESOR, Manager Electric Light Co, Lindsay, Ont.
W. H. BROWNE, Manager Royal Electric Company, Montreal.

## MARITIME ELECTRICAL ASSOCIATION.

President, F. A. HUNTRESS, Man Halifax Elec. Tramway Co. - Halifax, N. S.
Vice-President, P. R. COLPITT, City Electrician, - - "
Secretary-Treasurer, R. T. MACKEEN, Halifax Tramway C . - "

## ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

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**The Canadian Electrical Association.** A MEETING of the Executive Committee was held at Ottawa recently when all preliminary arrangements were made for the Annual Convention. The dates selected are the 27th, 28th and 29th of June. The headquarters during the Convention will be at the Russell House, where the meetings of the Executive and of the Association will take place. A number of suggestions were received from members relative to subjects for papers, and a committee was appointed to make a selection of subjects and authors. A strong committee was appointed to make the necessary local arrangements, and it is certain, in view of the success which attended the Convention previously held in Ottawa, that the approaching meeting will be one of the best in the history of the Association.

**The Discovery of Commeicial Incandescent Lighting.** THE article in our last issue referring to the invention of incandescent lighting has awakened considerable interest. The statement was omitted from this article that Mr. Edison's first incandescent lamp patent, No. 214636, was issued April 22nd, 1879, and that the basic patent on high resistance filament was issued May 4th, 1880. Mr. Edison filed his first application for a patent on a paper carbon filament December 11, 1879. The patent of April in that year was really a thermostatic regulator for each lamp. The Ottawa Journal, in referring to the article, quotes the remark of a cynical scientist, that "Mr. Edison has never invented anything, but that a skilful adaption of the electrical adaptions—for the term 'invention' when electricity is the master is rather an uncertain term—and a free use of newspaper advertising has given him his notoriety." The Journal questions our statewent that the principle of electric lighting was discovered in Toronto prior to Edison's invention, and dips deep down into the history of electrical science to prove that the principle was known prior to the date of the Toronto discovery. Our statement referred to commercial incandescent lighting, although it was not stated. It is a well known fact that the use of carbon enclosed in a vacuum or gas for the production of continuous electric light was not discovered until the period mentioned. It was well understood, previous to that time, that light could be obtained by heating carbon by means of an electric current, but the carbon, when thus heated in the atmosphere was speedily destroyed, and the light could only be maintained for a very brief period. In connection with this subject the reader is referred to the chapter reproduced in another column from a Brochure entitled "Wireless Telegraphy," by Richard Kerr, F. G. S., describing experiments made in Scotland by James Bowman Lindsay, who is said to have succeeded in lighting his room by electricity, and to have publicly exhibited an electric lamp in Dundee in the year 1835.

**The Nernst Lamp.** Referring to the Nernst method of electric lighting as invented by professor Walter Nernst, of Gottingen, Germany, we pointed out in a previous issue that a great drawback to the commercial development of the lamp is the necessity of heating the rod before it will light. Experience has proved that this has been an almost insurmountable difficulty. Numerous patents have been taken out in Germany for a quick-acting, reliable automatic heater, and while a measure of success has been

attained, the practical difficulties do not yet seem to have been overcome. We have read a brief account of the first commercial application of this lamp, and it is due to the inventor to state that the claims of high efficiency have been borne out. When Prince Albert of Prussia visited the University of Gottingen, his apartments were lighted with Nernst lamps, and now the lamp is being advertised in that city for house and store lighting. The lamps are to be used on the regular 110 volt circuits. A 25 c. p. lamp operates on 33 watts, or 1.3 watts per candle power. This is about double the economy which has been attained by the incandescent lamp. The Nernst lamps thus far used have the heater placed in close proximity to the staff, and consequently can only be used for low candle power. Another type of Nernst lamp has been invented, however, which is designed for higher candle powers, and which, it is thought, may overcome the objections above referred to. It cannot be said that the experiments have produced results which give promise of bringing it into general use. and for the immediate future at least the present form of vacuum lamp will continue in use. In this connection we may refer to some statistics of the incandescent lamp submitted by Mr. Barstow to the Brooklyn Institute of Arts and Sciences. Mr. Barstow pointed out that the incandescent lamp is now in its twentieth year and that the total production in the United States is about 20,000,000 per year. The different varieties and forms in which the lamp appears number over 147,000. The price of the lamp has been reduced from one dollar to eighteen cents each ; and while the cost today is but one-fifth that of twenty years ago, the efficiency has been increased but three times.

**Is Electricity Dutiable ?**

THE United States Treasury Department has been asked to give its decision as to the legality of collecting a duty on electricity. The Ontario Power Company purpose generating electric power on the Canadian side of Niagara Falls and transmitting it across the border, where it will be utilized for light and power. Those who desire that a duty should be placed on the electric current argue that it is a vendable and valuable product of manufacture, which can be easily and accurately measured. On the other hand, it is declared that the electric current cannot be regarded as an "article" within the meaning of the law, that it has no power to do work but only serves as a means of transmitting power, and that it is utterly impossible to import electricity because it instantly returns to its source. This question has alway been a debatable one. Some years ago the Treasury Department of the United States handed out a decision to the effect that no duty could be collected. The Dominion Government in 1893 took an opposite view, the Controller of Customs deciding that electricity brought into Canada from the United States should be subject to a duty of twenty per cent., on the ground, if we remember rightly, that it was an "unenumerated manufactured article." The Electrical Review, in support of its contention that no duty can be collected, makes the following original comparison : "Suppose two pulleys, one on each side of the Niagara river, with a rope or belt connecting them. This arrangement would transmit power if one of the pulleys is turned. Similarly, while it was running there would be a more or less rapid importation f the belt, and an exactly similar exportation. And it could not be said with truth that such an arrangement constitutes an importation of power, for the power, in its applicable form, does not exist in transit, but only at the driven pulley. Now this arrangement is an exact analogue of an electrical power transmission."

**The Proposed Dodge Telephone Company.**

IN another column will be found a letter from the promoter of the proposed Dodge Telephone Company in reply to the article printed in our February number referring to this company. This letter when read in connection with our previous article, must be regarded as being a clever piece of special pleading rather than a clean cut defense of our criticisms of the company's business methods. For example, the promoter states that the company has not decided whether to apply for a Provincial or Dominion charter, and that the decision with regard to this matter will largely depend upon the number of applications which may be received for preferred stock. In another part of his letter, however, he states that the purpose of the company is to operate at first in the provinces of Ontario and Quebec, and afterwards through the Dominion. Seeing that the company could not operate in the two provinces mentioned without a Dominion charter, the reason given for deciding upon the character of the charter and for the delay in obtaining a charter falls to the ground. We deny the contention that it is a usual practice for the promoters of a company to solicit stock before a charter has been obtained and a board of directors appointed. On the contrary, the usual course is to first secure a charter, and second to appoint a strong board of directors in whom the public will have confidence and who will therefore induce investments in stock. If as the promoter states a large number of applications for stock have already been received, there should be no difficulty in appointing a board of directors and in publishing their names. The investing public have also a right to know the character of Mr. Dodge's patents for which he is to be paid the magnificent sum of $1,500,000. As the fundamental patents on telephone apparatus are public property, it would appear that Mr. Dodge's patents must be on subsidiary devices or combinations which cannot be considered essential to the conduct of the telephone business, and the intrinsic value of which is likely to be far below the sum which the company propose to pay to Mr. Dodge. Special stress is put upon the necessity of organizing the company in such a way as that competitive companies shall not be able to secure control of the stock, but the public have a right to enquire who is to guarantee that Mr. Dodge will not sell out his stock, and thus place the control of the company in other hands. Our readers will observe that the promoter offers to waive the clause in the company's prospectus to which special objection was made in the previous article, which gives the company the right to apply to expense account the deposits of applicants for stock, even in cases where their applications may not have been granted. This clause has evidently been dropped because it was found too hot to hold, and we predict that other changes will also have to be made for the satisfaction and security of the public before the proposed company can successfully establish itself.

The Columbia Telephone Co., of Grand Forks, B. C., now operate over 500 miles of line. They propose to extend their system this year into the Similkameen country.

# TELEGRAPH and TELEPHONE

## DISCOVERY OF WIRELESS TELEGRAPHY.

The following chapter, reviewing the life of James Bowman Lindsay, who in his day made wonderful experiments with electricity, is taken from a brochure on "Wireless Telegraphy," by Richard Kerr, F.R.S :

JAMES BOWMAN LINDSAY.

Born 1799 : Died 1862.

In giving an account of any discovery or invention, it is but right to give honor to whom honor is due. Therefore we cannot refrain from paying a tribute to the memory of the man who, in these islands at least, was the first to suggest a method of signalling across space without intervening wires. Not only did Lindsay suggest, he also carried out successful experiments in proof of his theories.

It would not be easy to name a greater genius than James Bowman Lindsay, nor a more noble character. Certainly few, if any, have accomplished so much in a life-time of penury. All his life long he must have pinched himself to the utmost limits in order to purchase materials for his numerous experiments. He worked, and worked alone, on the borders of starvation. He had no house ; only one room could he afford, but that one room had in it more than any palace in the kingdom. It was lit up by an electric light of his own installation in the year 1835. It is difficult to realize that sixty-three years ago a room could have been so illuminated. That same room was famous for other reasons. It was here he wrote several of his works, and that portion of his dictionary in fifty different languages, which, in his own handwriting, is in a glass case in the Dundee Museum.

When I saw that manuscript, and the vision of his life struggle passed in a moment through my mind, I removed my hat in reverence for the memory of that poor but rich linguist of Dundee. A short account of what he accomplished under enormous difficulties will be acceptable now that telegraphy without wires is occupying so much attention.

James Bowman Lindsay was born in 1799 at Carmylie, and was taught weaving, and from earliest youth he endeavored to educate himself. In 1821 he entered St. Andrews as a student, working at his trade during the college recess. In 1829 he was appointed lecturer and teacher at the Watt Institution, Dundee. After finishing his arts course, he became a divinity student, but never took license. In 1841 he was appointed teacher in Dundee prison at a salary of fifty pounds. He was a diligent student of science, made many discoveries, and published many works. It was possible that he was the first to use electric light. Not only did he succeed in lighting his one room in 1835, but he publicly exhibited an electric lamp that same year in Dundee. In 1845 he suggested the possibility of extending the electric telegraph to America. In 1853 he maintained that it was possible to establish electrical communication through water without connecting wires. In 1854 he patented this invention. That same year he conducted experiments in London and at Portsmouth, where he successfully telegraphed without wires across water 500 yards wide. In 1859 he telegraphed in this manner across the river Tay at Glencarse, where it is about half a mile wide, and read a paper on this subject before the British association assembled at Aberdeen.

In presence of the members he conducted experiments at Aberdeen docks, which successfully proved the correctness of his theories. During the last two or three years of his life he had a pension of one hundred pounds granted by the Queen on the recommendation of Lord Derby. In his experiments Lindsay was very successful but it is a matter of doubt whether his suggestion as to signalling to America would have met with success, even if facilities had been granted for the trial. At the same time, it is hardly fair to condemn the suggestion in the absence of the man. The genius of the mind that could invent wireless telegraphy, and the indomitable energy that could encounter the labour of writing a dictionary in fifty languages, cannot easily be set aside or even deemed in error ; we do not know all the resources that were behind the suggestion. That his was a prescient mind also will be seen in the remarkable words inserted in the advertisement announcing the opening of his science classes, which appe in the Dundee Advertiser of April 11, 1834: "Houses and towns will in a short time be lighted by electricity instead of gas, and heated by it instead of coals, and machinery will be wrought by it instead of steam, all at a trifling expense." Fancy all this foretold sixty-four years ago. Some of Lindsay's experiments were made in the presence of a turnkey of the gaol and a young friend who is now a venerable old gentleman, highly respected in Dundee. This friend, Mr. Louden, sr., tells me that Lindsay would station them on one side of the Tay, requesting them to watch carefully the needle he had placed in position, and to note how it moved. He would then insert his plates in the water on their side of the river, and crossing over to the opposite side, would complete his arrangements. His battery, containing twenty-four Bunsen cells, would be set in action. Later on Lindsay would return, and question them eagerly as to the behaviour of the needle. The different movements to the right and left would be noted, and, on comparing them with the messages he had sent from the other side, he was perfectly satisfied he had accomplished telegraphy without continuous wires. He would then return to his little room as happy as possible. It is comforting to know that the studious Lindsay, with all his poverty, got some satisfaction and joy in this life. Nowadays we can purchase batteries and wires and all electrical appliances at a moderate cost, and every detail ready for immediate service. It was not so in Lindsay's day. He had to make up his cells, and possibly to coat and otherwise insulate his wires. Mr. Louden knows that Lindsay had to make his own intensity coils, and he tells me that one particular coil used in his earlier experiments was 4½ feet long and contained five miles of wire. Think of it. Think of the cost, and where the money was to come from. Think of the patience of the man with primitive and limited appliances. The modern experimenter in electricity has no difficulties compared with those combated by Lindsay. Besides, in Lindsay's case, more wire, more acids, more metals, ment less food, less new clothes, less comforts of all kinds. Before looking into this remarkable room of his—which if now existing would be a sacred spot to the scientific mind of to-day—let us refer once more to his practical experiments. One of the first demonstrations of his theories took place at Earl Gray dock, Dundee, in presence of many men of science. He immersed seperarate plates in each side of the dock, and transmitted messages with ease and accuracy. Going to a wider expanse of water, he repeated his experiments across the Tay at Dundee and Woodhaven, where the river is nearly two miles wide. These wonderful experiments were the chief topic of conversation at that time in Dundee, but nothing was done to give them a practical bearing. This was not Lindsay's fault. The business of the philosopher is to find out the mysterious forces in Nature, and simply to indicate their application. It remains for others, who have the necessary capital and practical ability, to adopt the ideas and suggestions and to shape them to a useful result. The philosopher's part was done and well done. If the term "philosopher" does not apply to Lindsay, it never applied to any man. How is it that there is no memoir to this man's life and doings ? Where is the statue to his memory in Dundee ? I have seen statues in large cities to the memory of men not worth remembering—men who rose to fame on other men's shoulders ; men who, in point of morality and genuine worth, were not fit to enter his little room, or to polish poor old Lindsay's boots. But if Lindsay's wishes could be ascertained, he would ask for no statue. It is more than probable he would suggest a large lecture hall, to which the public could have free access to hear unfolded the grand mysteries of Nature, to the study of which his own life was devoted. Doubtless the time will come when the people of Dundee will do their duty, and honor themselves by honoring the memory of Lindsay. Few men who ever saw light on these islands of ours so completely ignored self on behalf of science, or with so much earnestness of purpose have struggled against poverty and accomplished so much ; for it must be borne in mind that "Lindsay's work as a linguist was as remarkable as his scientific discoveries, and would have made a reputation for him rivalling that of Mezzofanti."

But we have not yet peeped into those famous rooms of his. Sir W. C. Leng writes : "James Lindsay the learned Carmylie weaver, died while I was in Dundee, 1862. His rooms (two rooms now that he had a pension) on a flat near the harbor, were walled round with books, and had stacks of books on the floor. His great work in manuscript—a dictionary of twenty-six* languages, lay arrested by death on the table.

"He had got a volume of ponderous bulk, and had ruled it in narrow lines across and across, so as to allow of the equivalent of each word being written in many languages, in a small hand, on the same line as the original. Very pathetic was the testimony borne by that book to the old man's ambition to leave something monumental behind him, and the manner in which his hand had been stopped in the midst of his labors."

*It was a dictionary of fifty languages.—R. K.

## THE DODGE TELEPHONE COMPANY OF CANADA.

To the Editor of the ELECTRICAL NEWS:

SIR,—We observe, not without some degree of satisfaction, that the prospectus of the proposed Dodge Telephone Company of Canada, Limited, has received attention at the hands of your editorial department in the February number of your Journal; and in reply to your criticisms, which we will endeavor to take up, point by point, as closely as may be possible under the circumstances, beg to submit the following statements:

We believe it is not at all unusual for companies of a broadly public character to solicit subscriptions for their stock, prior to the work of organization being entirely completed. And there exists some excellent reasons in their particular instance for deferring for a time this important step. In the first place, the proposed company can procure incorporation under two different joint-stock company acts—the Dominion and the Provincial. The chances are certainly at present all in favor of Dominion incorporation; but a good deal will depend upon the total amount of the 8 per cent. preferred stock, which will be taken up and accepted during the next three or four months. We desire to proceed surely and at the same time very cautiously; and if a sufficient quantity of this stock is placed within a few months hence in hands perfectly satisfactory to the management, a Dominion charter will certainly be obtained. Moreover, we are advised that it may be advisable to apply either to the Dominion, or to the Local Legislature—which will depend, of course, upon the particular Act that will be chosen for our purposes—for certain special legislation, that may be desirable, if not absolutely necessary, in our interests.

With regard to the issue of the prospectus before the Provisional Board of Directors was filled up, we may simply say that we are extremely anxious to select a Provisional Board having the very widest and most representative character possible, and this work has as yet not been finished; still we hope, within a very short period of time, to be able to place before the public a Board whose composition will be equally satisfactory both to ourselves and to the investing public.

With regard to the holding back of a very large block of, and a controlling interest in, the Stock, we can give several reasons, which we consider ample justification for the adoption of this policy.

In the first place, it is no secret at all among those conversant with the manipulation that frequently occurs in connection with the launching of such enterprises, that such an active competition as is intended in this case-which competition is further certainly in the very best interests of the general public-could be prevented in the easiest possible manner by the simple expedient of securing subscriptions for a controlling interest in the stock of the company. This plan was successfully adopted a few years ago in Montreal, and the principal promoter in the present company was still more recently foiled in his plans in New England by a somewhat similar subterfuge. And he thought that in this very instance he had the greater reason to complain, in view of the fact that he was sold out by intimate friends, whom he had benefitted, and who would have been benefited in still greater degree by the continuation of the system which he had been chiefly instrumental in calling into active existence.

Now it may be well to state at this point, and in the most emphatic manner, that the promoters of this company have but one object in view in bringing the claims of this projected telephone company before the public—the establishment upon a permanent basis of a strong independent telephone company to operate, first, in and between the large cities of the Provinces of Ontario and Quebec, and afterwards throughout the remaining suitable parts of the Dominion. We find an impression prevailing in some quarters that it is in the plans of the promoters to sell out eventually to the existing company, but there is absolutely no ground whatever for such a report, which may well have been put in circulation by interested parties. However, enough has happened elsewhere in the United States to give color to such rumors, although the results prove with equal force that the existing company eagerly takes advanage of every available opportunity for effectually extinguishing opposition by a purchase. The controlling interest simply in the Detroit and New State Independent Telephone Companies, for instance, recently cost that organization $1,245,000. The capitalization in question amounted to $2,500,000, of which some $1,400,000 was paid up.

The common stock in the proposed Dodge Telephone Company represents in addition compensation to Mr. Dodge for his patented improvements in telephone instruments and practice, which will be found to be possessed of unusually great value, while a portion, as is not all uncustomary in the case of company flotation, may be used in the shape of promotion stock. The subscribers to the 8 per cent. preferred stock will however be in no way prejudiced in regard to these matters, as they will have an undoubted first lien to the extent of eight per cent. per annum upon the profits earned. And as you are doubtless aware, telephone propositions have been found to be very profitable enterprises.

Finally we may say that there is no intention, and never has been any intention, on the part of the promoters of this company to retain any part whatever of any subscription for stocks, which subscription has not been accepted by the Directorate. However, as many people appear to read the clause in question in a similar light, and as there is now no question whatever of the successful flotation of the company upon the scale desired by the projectors, we have not the slightest objection to drop altogether this particular clause, which would, of course, in that event be wholly inoperative under any circumstances whatever. We have no wish to bring into life utterly useless bugbears, on which hostile influences will naturally seize, in the hope of doing some mischief, even though they do not succeed in their main design—the complete extinction of opposition in the great Canadian field.

And you will be rejoiced to learn, in answer to the concluding portion of your editorial criticism, that many applications for stock have been already received, and that the future prospects of the company are all in all of the most satisfactory possible character. I am,

Yours very truly,

J. A. MACMURTRY.

## THE BELL TELEPHONE COMPANY.

The annual meeting of the Bell Telephone Company was held in Montreal on February 22nd. A very satisfactory report of the year's business was presented. The total revenue from exchanges, long distance lines, private lines, etc., amounted to $1,456,682, and the expenditure $1,103,375, leaving a net revenue for the year of $353,307. The statement showed the plant and patents on December 31st, 1899, to be valued at $5,244,436.33. The annual statement was in part as follows: 2841 subscribers have been added during the year, the total number of sets of instruments now earning rental being 34,923. The company now owns and operates 343 exchanges and 450 agencies; 1686 miles of wire have been added to the long distance system in 1899; of these 318 miles are in the Ontario department and 1368 are in the eastern department. The long distance lines now owned and operated by the company comprise 18,920 miles of wires on 6,229 miles of poles. Since the last report, the building in London has been completed, a building has been erected in Parkdale, and a building for the stores department has been erected on Mountain street, Montreal, all of which have been paid for.

The report was unanimously adopted and directors elected as follows: C. F. Sise, Robert Mackay, John E. Hudson, Robert Archer, Wm. R. Driver, Hugh Paton, Charles Cassils, and Thos. Sherwin.

## SHORT CIRCUITS.

The New Brunswick Telephone Co. have decided to build a line next summer between St. John and St. Stephen, N. B. The company will in the spring commence the proposed line between Fredericton and Chatham.

The Union Telephone Co., of Musquodoboit, N. S., at their annual meeting last month, elected officers as follows: President, Edgar Archibald; vice-president, James Annand; secretary-treasurer, H. C. Taylor.

The Nova Scotia Telephone Co. are considering the advisability of extending their long distance service from Halifax to Sydney, C. B. It is understood that the expenditure would be about $50,000, a large proportion of which would be spent in making cable connection across the straits of Canso. Mr. C. Harris of Halifax, is manager of the company.

The annual meeting of the Montreal Telephone Co. was held in Montreal January 11th last. The annual report showed the total assets of the company to be $2,267,811, divided as follows: Telegraph cables, $33,487; offices and equipment, $212,500; real estate, $279,946; and cash, other real estate, amounts receivable, etc., $115,988. The excess of assets over shareholders' capital was stated to be $151,823, and the contingent fund $7,548. There were declared during the year four quarterly dividends of two per cent. each, a very satisfactory showing. The old board of directors was unanimously reelected, and at a meeting of directors Mr. Andrew Allan was again elected to the presidency.

# MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS, New York Life Building,

MONTREAL, Jan. 3rd, 1900.

THE LACHINE RAPIDS COMPANY.

THE annual meeting of the Lachine Rapids Hydraulic and Land Co. was held about two weeks ago. The report of the directors stated, according to the local press, that notwithstanding the fact that since the last annual meeting further discounts had been allowed to customers, the company was firmly established on a paying basis. During the year the expenditure authorized on capital account was $413,709, this representing improvements at the rapids and machinery ordered but not yet delivered. The two 1,000,000 gallon fire pumps had been completed, and steam pipes, with hose, etc., provided and installed. Two of the four generators ordered in 1898 were delivered and put in service. There were at present on the company's circuits 493 transformers, with a total capacity of 66,740 sixteen candle-power lamps. The net increase in incandescent lamps connected to the circuits during the year amounted to 16,114, showing a total of 56,249 lamps connected. The total amount of current sold as power amounted to 1,954 horse-power, being an increase of 1,030 horse-power during the year.

The report stated that several extensions to the underground system of the company had been made, and in this connection the directors referred to the advantages of the underground system. Since its installation there had not been a single accident or interruption. The financial statement showed the gross revenue for the year to have been $164,834.78, and the operating expenses $72,-798.10. After paying interests on bonds, a net profit of $69,128.-04 was shown.

The directors were re-elected, and at a subsequent meeting they elected officers as follows: G. B. Burland, president; Alexander Fraser, vice-president; W. McLea Walbank, managing director; Robert White, secretary-treasurer.

The case of Wm. Dwyer against Frothingham & Workman for having had his arm paralysed by an electric wire used for an incandescent lamp in the factory of the defendants, and from which the globe had been removed, has been amicably settled by the defendants consenting to pay $600 damages and costs. The man had to be taken to the hospital, where an operation was performed on his arm.

A Mrs. Price appeared a few days ago before the Society for the Protection of Women and Children and made application for funds to enable her to sue for compensation on account of her husband being killed by electricity. She was informed by Mr. Marshall, the secretary, that this did not come within the scope of the Society. The above no doubt refers to a case which happened in this city lately, where an operator at the incinerator was employed on top of a heap of rubbish outdoors in cleaning out some sort of melting pot or crucible with the aid of a long iron rod. The sediment, whatever it was, being evidently stubborn, he raised his rod to take a more forcible blow, with the result that the upper end of the rod crashed into an arc light which was suspended above and which was on a constant current direct current circuit. The man dropped at once and was shortly pronounced dead.

The premises being built by the Estate McIntyre on the site of the old Greenshields warehouse, corner of Victoria Square, and which were destroyed by fire about a year ago, are being wired for enclosed type arc lamps, also for several incandescent drop lights by the Montreal Electric Co. This construction firm are using for the first time in Montreal the Greenfield flexible metallic conduit as manufactured by the Sprague Electric Co., of New York, they deeming it most suitable for use in the peculiar floor construction (fire-proof) being placed in this building.

Messrs. Fred. Thomson & Co. had a small fire on their premises recently, damage being done to the extent of $1,500, covered by insurance. As an offset to the daily papers I would state positively that the fire was due to the deadly "stove," which got overheated.

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The Bathurst Power Co., of Bathurst, N. B., is seeking incorporation, to build dams and operate electric and steam plants on the Nepisguit and Tetegouche rivers, in New Brunswick.

# CORRESPONDENCE.

## THE RECENT ACCIDENT IN MONTREAL.

OTTAWA, ONT., March 3rd, 1900.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR,—In the February number of your journal appeared an editorial commenting upon an accident in Montreal, resulting in the death of Mr. Alphonse Girouard. This matter was brought up for discussion at the last meeting of Court Elektron I. O. F., which is a Court of the Independent Order of Foresters in Ottawa composed of persons engaged in the electrical business. The undersigned was instructed to write you concerning part of the aforementioned editorial, which is to the effect that "in order to permit of the accident the inside wiring must have been grounded.' It was the unanimous opinion of those present at the above meeting that had the inside wiring been subject to a good "ground," the accident could not have happened, as the current would take the much easier path at the grounding of the wires rather than through the body of deceased.

As such accidents may materially effect a large portion of the electrical business, it is thought that this matter should not be let drop until thoroughly discussed and fully investigated, and to this end a further argument on the subject would not be amiss.

Yours truly,

EDMUND J. O'REILLEY.

[An expression of opinion from the electrical fraternity on the above subject is solicited.—THE EDITOR.]

## PERSONAL.

Mr. A. T. Smith, superintendent of the Bell Telephone Company, has transferred his headquarters from Kingston to Toronto.

Mr. Stanley Shepard, superintendent of the Valleyfield Electric Company's power house at Valleyfield, Que., has accepted a more lucrative position in Rio de Janerio, South America.

Mr. J. S. Grant, chief engineer of the civic electric light plant of New Westminster, B.C., has tendered his resignation. A successor has been appointed in the person of Mr. J. J. Healey.

Mr. Frank Jackson, a student in the engineering department at Queen's University, Kingston, has received an appointment in the office of the Canadian General Electric Company at Peterboro.

Mrs. Black, mother of Mr. Geo. Black, manager at Hamilton of the Great North-Western Telegraph Company, died in that city a fortnight ago. The deceased was born in Auchterarder, Scotland, and was ninety-one years of age.

Mr. P. Bowler, city electrician of New Westminster, B.C., has resigned his position, and has been succeeded by Mr. Thos. Proctor, of Fort William, Ont. Mr. Proctor was for a number of years electrician on the steamer Empress of India, and also acted in that capacity for the North British Railway.

## HOW HE WON SUCCESS.

A prominent technical journal in a recent issue contained a pithy paragraph answering an eastern daily which referred disparagingly to correspondence instruction. A reader wrote a letter thanking the editors for their stand and stating that he owed his success largely to a course in a correspondence institution. This is the case of hundreds of men to-day. Never in the history of the world has the poor but ambitionus man had such opportunities as are presented to him to-day. It is the lack of technical training that keeps bright young men down. Few can attend college; they are compelled to work every day. But now anyone can have a private instructor. The correspondence institution goes to him at his convenience.

There is no boy so poor but he could manage to pay the moderate charge of the American School of Correspondence, situated at the famous seat of learning, Boston. A careful inspection of the school's attractive instruction papers convince one of the painstaking thoroughness and accuracy which distinguishes the work of this New England institution. The school is chartered by the Commonwealth of Massachusetts, and enjoys the respect and confidence of thousands of earnest students throughout the United States. The instructors are all graduates of leading scientific schools and have had valuable experience along engineering lines. The benefit to the student of this expert supervision cannot be overestimated.

# ELECTRIC RAILWAY DEPARTMENT.

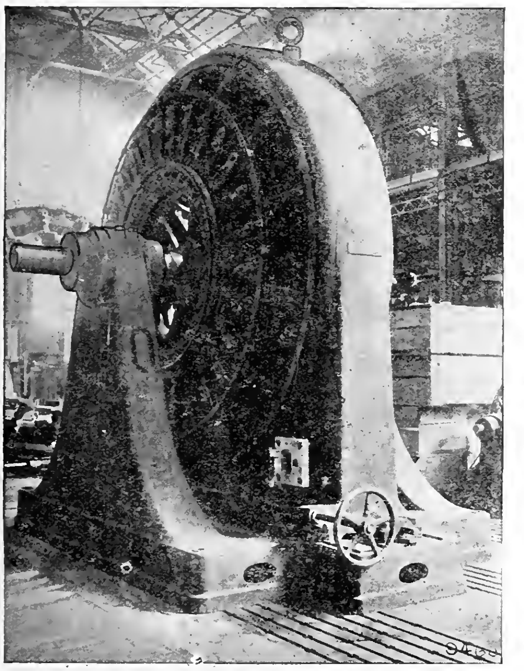
## DOUBLE CURRENT GENERATORS AND ROTARY CONVERTORS.

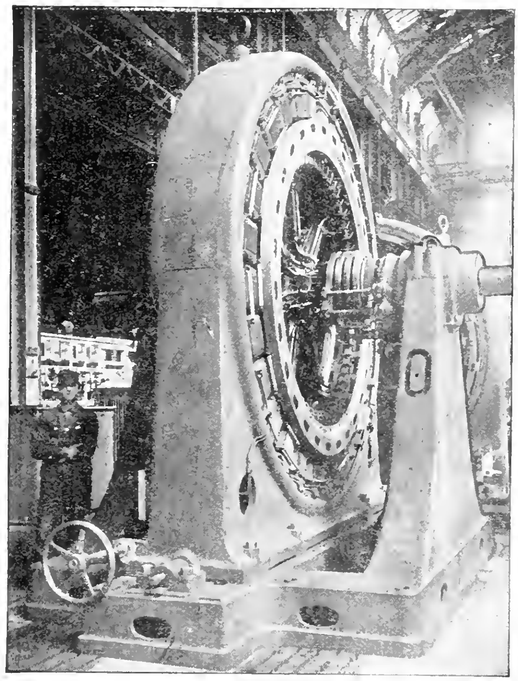
In the operation of street railway systems, double current generators and rotary converters promise to form an important part of the station equipment in the future. The Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa., have recently supplied several machines of the above types for street railway work. The double current generators installed by the Metropolitan Railway Co., of Toronto, were described in a recent issue of the ELECTRICAL NEWS. On this page we give illustrations of a 600 k.w. double-current generator installed for the Quebec Montmorency & Charlevoix Railway by Messrs. Ahearn & Soper, of Ottawa, Canadian agents for the Westinghouse Co. This machine is direct connected to a water-wheel, receiving power from the Montmorency Falls, and operates at a speed of 286 revolutions per minute. It has 28 poles, and delivers direct current at 550 volts and two-phase alternating currents at 8,000 alternations and about 400 volts. It will carry its full rate of load on either end, or it will divide the load of direct and alternating current in any proportion that may be required. The direct current is fed into the railway line adjacent to the station and the alternating current is transmitted at a high voltage to a sub-station some distance away.

The Westinghouse Company have supplied for the Third Avenue Railroad at New York, six of the largest rotary converters yet constructed, having ten poles and operating at 300 revolutions per minute. Four of these are now being used as double current generators. They have large over-load capacities, so that when working under full load continuously there is very slight rise in temperature. These machines are rope driven from horizontal steam engines, direct current being taken from the commutators at 550 volts for feeding the railway circuits, and from the collector rings are taken alternating currents at approximately 350 volts. From this pressure these latter currents are raised by means of step-up transformers and transmitted to the 129th street station to operate a similar machine now used as a 1,000 k.w. Westinghouse converter. These double current generators can be changed to rotary convertors whenever desired. This is done by cutting off the shaft and by the addition of a starting motor. The rotating part of the starting motor is pressed upon the armature shaft of the rotary.

It is claimed that to gain the best results with double current generators it is necessary that they be operated at a high speed to avoid a multiplicity of poles. For this reason they are especially well adapted for direct connection to water wheels. The greater flexibility afforded to a station by the use of double current generators is almost certain to bring them into general use for both railway and lighting circuits. Since they are able to deliver their regular output as either direct or alternating current, or a part of each at a low voltage, the direct current is at once available for use on the three wire systems without passing through any auxiliary machinery, and the alternating current, although not suitable for service at a distance on account of its low voltage, can be raised by transformers.

It is pointed out also that storage batteries may be very advantageously used in connection with double current generators, either to increase direct current capacity at time of maximum load, or to supply the entire output of both direct and alternating currents at time of minimum load, and to regulate the station pressures for both the direct and alternating current at any load.





VIEWS OF 600 K.W. DOUBLE CURRENT GENERATOR—QUEBEC, MONTMORENCY AND CHARLEVOIX RAILWAY.

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At a meeting of the city council of Moncton, N. B., it was decided to take steps to compel the Moncton Street Railway Co. to operate its road within six months or take up the rails.

It is understood that an agreement has been reached by which an electric railway will be constructed in the town of Woodstock, Ont. Mr. J. C. Wallace, representing the promoters, states that cars will be running in six months.

The Lulu Island Railway Co., of New Westminster, B.C., have decidtd to build an electric tramway from Granville street, Vancouver, to a point on the north arm of the Fraser river. It is also contemplated to build a branch from New Westminster to the North Arm False Creek line, making about 13 miles new road.

# ENGINEERING and MECHANICS

## THE GASOLINE ENGINE.

By H. S. Pell.

My intention this evening is to bring before you, in as practical and familiar a way as possible, the main features of the gasoline engine, and I trust that none of my audience will be disappointed if the intricacies of the subject are omitted. In the first place, it would be well to consider the characteristics of the fuel used, viz., 74 degree gasoline. Gasoline, as you all know, is derived from crude petroleum during the process of refining, and being one of the lighter constituents of the parent oil, it possesses not only the quality of inflammability, but is extremely volatile, vaporizing in the open air at ordinary temperatures. I have here a small phial of gasoline, and its volatile quality is readily observed by taking a small portion upon the palm of the hand; it will be seen to evaporate almost immediately, and it is this quality which makes it specially valuable for power purposes, as gasoline is virtually liquid gas and can be readily mixed with a proper proportion of air and burned under such conditions as to produce motion.

As regards its inflammability, there is a popular impression that gasoline is explosive and extremely dangerous to handle, but this impression springs more from a lack of knowledge than from the facts of the case. As I will now proceed to show you, gasoline burned in liquid form produces a strong, quick flame, but does not give an explosive effect by any means, and when it is considered that such a liquid as gasoline must first become a gas, and further must be mixed with a certain proportion of air before in can be exploded, it will be readily seen that only very simple measures are necessary to ensure perfect safety, viz., handling it by daylight only, and keeping it in air-tight receptacles.

I will now draw your attention to the drawing of a gasoline engine which I have on the platform, and you will at once observe in it a striking similarity to the ordinary steam engine. Both have cylinders, valves, pistons, connecting rods, cranks and fly wheels. As a matter of fact, both are heat engines, the steam engine employing what might be termed external combustion and the gas and gasoline engine internal combustion. There is, of course, an entirely different cycle of operations in the two machines. The steam engine utilizes the energy of some combustible which is transferred to water and carried to the engine in the form of steam. The gas or gasoline engine utilizes the energy of hydro-carbon or other gas, by burning it directly in the cylinder, thus causing expansion of the air drawn into the cylinder on the suction stroke, thus imparting motion to the piston. Chemically stated, the oxygen of the air and the hydrogen and carbon of the gas are the elements which, by combustion, expand the nitrogen of the air and the watery vapor produced by the union of oxygen and hydrogen, and also carbon dioxide and carbonic acid gas formed by the union of carbon and oxygen.

Most commercial engines operate on what is known as the "Otto cycle," which is carried out during two revolutions, or four piston strokes of the engine. We will consider this cycle as applied in the ordinary single acting engine, and commencing with the suction stroke, we will turn the fly wheel and cause the piston to move a full stroke outward. The result is naturally to create a vacuum in the space between the piston and cylinder head, and to open the automatic inlet valve A, allowing air to rush in and fill the cylinder space. This air is drawn through a somewhat restricted opening, and therefore passes through the cylinder ports and enters the cylinder with considerable velocity.

You will notice a little metal cup at the back of the cylinder. This is the gasoline receptacle, and is kept constantly replenished by a small pump operated by the engine and drawing its supply from the main gasoline tank. A small tube projects from the cup into the air part and the swiftly moving air current picks up and instantly vaporizes a few drops of gasoline on each suction stroke from this tube. The cylinder is therefore filled with a mixture of atmospheric and gasoline gas at the end of the suction stroke, and the whirling action of the air current effectively mixes the two elements. The openings for air and gas are so arranged that the proportions are about 8 parts of air to 1 part of gas, which forms a mixture affording the most complete combustion when lighted. The next stroke of the cycle is the compression stroke. Compression of the gaseous mixture gives a more complete infusion, quicker firing and far greater pressure. This compression is effected by the momentum of the fly wheel acting on the piston through the crank and connecting rod, and as both the inlet valve and the exhaust valve open inward, they automatically close on the reversal of the piston. At the end of the compression stroke the contents of the cylinder are at a pressure of about 60 lbs. per square inch in the majority of commercial engines, though both higher and lower compression is used in special cases. The piston is now at its extreme inner stroke, and ready for the third or power stroke. In order to utilize heat energy of the gas it is of course necessary to ignite it, and this is effected in modern engines in two ways, viz., by the electric spark and the hot tube.

By the former method, either a small dynamo, a storage battery or a primary battery is used to produce the necessary electric current. Where the dynamo is used the wires are carried direct to the make and break appliance in the cylinder, but where a battery is employed it is necessary to interpose a spark coil into the circuit. The igniter consists essentially of two conductors, preferably tipped with platinum, which are caused by suitable mechanism to break the circuit at the proper moment for ignition, and thus produce a spark. (The primary cell apparatus I have on the platform produces such a spark by suddenly breaking the circuit as described.) In practice the igniting points are brought into the interior of the cylinder and the spark is produced at the best point to secure efficient ignition of the compressed gases. The hot tube is much simpler than the electric apparatus. It consists merely of a small short tube of iron, nickel, platinum, or composition, open at one end and sealed at the other. The open end is screwed into the engine cylinder, and the tube having been heated to a dull red by a Bunsen burner, fed by gasoline from a small elevated tank, all is ready for work. The tube is, of course, kept canstantly heated by the Bunsen burner during the operation of the engine. When the gases are compressed into the hot tube they ignite at a moment which is controlled by the length of the tube, the shorter the tube the earlier the ignition and vice versa The moment of ignition can be precisely determined when electric ignition is used, by adjusting the sparkling mechanism, but with the hot tube the time of ignition is more or less experimental, and as ignition at the exactly proper moment is necessary for a complete combustion and good economy, it is evident that the electric spark has a point of advantage in this particular, but when the upkeep of batteries, and sparking points, and the annoying stoppages incidental to the use of electricity are considered, most operators of gasoline engines in my experience prefer the hot tube. The ignition of the gases causes a sudden and vigorous expansion of the air brought into the cylinder during the first or suction stroke, the pressure rising to 200 lbs. or more, according to the amount of original compression and the perfection of the mixture. This causes the piston to take a powerful stroke, and immediately on the completion of this stroke the exhaust valve is opened by a rod and cam and the burned products of the power stroke are swept out of the cylinder, and all is again ready for a new suction stroke, thus completing the cycle of four strokes, which I again name in order, first, outward suction stroke; second, inward compression stroke; third, outward power stroke; and fourth, inward exhaust stroke.

I will now proceed to a brief discussion of the component parts of the gasoline engine, using the part drawing of the Northey gasoline engine on the board for my purpose. In the first place, the bed presents no unusual features apart from its being extra massive and somewhat higher than a steam engine bed would be, owing to the larger fly wheels employed. The shaft runs in heavy bronze half-boxes planed to fit the sockets in frame, and held in place by cast iron caps. This part of the bed is specially stayed to resist the shock of the power stroke. The fly wheels are specially massive, two are used on each engine. The crank shaft is a steel forging. The crank is forged solid, and drilled and slotted out, as the best practice demands, and the whole is very carefully made to withstand the severe duty it has to perform. The connecting rod is a steel forging slotted out at the piston end, and provided with bronze boxes and wedge and screw take-up. It is provided with marine type brasses at the

*Paper read before Toronto No. 1 Canadian Association of Stationary Engineers. Explanations were given by means of models.

crank end, with turned steel studs, double lock-nuts and split pins. The piston is very deep, as it forms its own guide. It is provided with four or five rings of the spring type. The cylinder is water-jacketed all round, as shewn, this being necessary to keep the temperature of the inner wall of cylinder down to a point at which the special cylinder lubricating oil can do its work. A mineral oil with special qualities must be used, as heavy vegetable oil would thicken and even char in a gas engine cylinder, thus doing more harm than good. As the gasoline engine is a heat engine, this necessary cooling of the cylinder for lubricating purposes is very wasteful, 40% of the heat generated going into the cooling water. The cylinder head is also jacketed, as the inlet valve face in it must be protected from the fierce heat. The inlet valve is a mushroom shaped poppet valve, with a long stem carrying a spring which ensures its prompt closing. It is an automatic valve, which is opened when necessary by the vacuum produced in the cylinder. At the back is the little receptacle for gasoline mentioned earlier in this paper, and entering the bottom of the cylinder will be seen the air pipe with the gasoline injector protruding into it. On the horizontal part of this air pipe is a valve to control the proportion of air used, while the gasoline is varied in quantity by a needle-valve at the base of the gasoline receptacle. The hot tube and bunsen burner apparatus are seen at the top of the cylinder close to the back cover, and the lubrication of the cylinder is effected by a sight feed drop lubricator placed at the forward end of same.

On the side is the exhaust casing, valve and gear. The casing is water jacketed to protect the valve and seat, and the valve is the same as the inlet valve, viz., a mushroom shaped poppet valve. The value of a poppet valve in gas and gasoline engines lies in the fact that they lift squarely off their seats, and owing to the rush of air or gas through them, the seats are always kept clear of grit or dirt, which soon destroys any valve of the sliding variety.

Poppet valves expand evenly and keep tight under the trying circumstances met with in gas engine practice, and they are easily ground to place when worn or leaky. The proper opening of the exhaust valve is secured by the action of a cam operating a side rod. The exhaust cam is mounted on a secondary shaft which is set in motion from the main shaft by a pair of gear wheels, of unequal size. The gear on the main shaft has one-half the number of teeth of that on the cam shaft. This is necessary from the fact that the exhaust valve is opened once during two revolutions of the main shaft. Where electric ignition is used, the secondary shaft also operates a switch or cut-out, allowing the current to pass only at the beginning of the power stroke, and thus saving the battery. Both inlet and exhaust valves are held to their seats by spiral springs. We have now briefly mentioned the essential parts of the gas or gasoline engine, for a gasoline engine can be easily arranged to use gas. In fact either gas or gasoline can be used at will in the Northey engine. Where gas is used a combined air and gas valve is employed, which automatically adjusts the supply of air and gas in proper proportions.

We will now consider the governing apparatus, taking the Northey engine governor as our example. It will be realized that the governor is a very important part of the mechanism, as its duty is to proportion the number of impulses that the engine will run at practically the same speed from no load to full load. The governor works on the well known principle of centrifugal force operating through a pair of weights so attached to the main shaft as to move a sliding collar along it. This collar has a lip at its outer edge which engages a pivotted finger, the steel tip of which is formed into a knife or chisel edge. This tip moves inward or outward in sympathy with the motion of the governor balls, and is so arranged that it will catch upon a similar chisel edge formed upon the exhaust valve rod. The purpose of this mechanism is that when the engine speeds up a couple of turns more than the normal speed, the pivotted finger is pressed in far enough to catch the detent on the exhaust valve rod and hold the exhaust valve open. The motion of the exhaust valve rod also brings a thin bar of steel behind a collar on the inlet valve stem and holds the valve tight closed. When the parts are in this position the engine cannot draw in a charge of gas or gasoline, and cannot compress because the exhaust valve is wide open. All that can happen, therefore, is that air is alternately drawn in and forced out of the cylinder, incidentally clearing out the spent gases. After a few revolutions the speed of the engine comes down to normal, and as the governor balls come together the governor finger is withdrawn and the exhaust valve closes, while the inlet valve is allowed to open by the withdrawal of the bar. A charge of gas and air is at once drawn in, compressed, fired and exhausted, and the operation is repeated until the governor again comes into action. So perfect is the action of the hit and miss governor, as this type is named, that though the power is applied only every fourth stroke, we are enabled to run a dynamo and operate electric lights with remarkable steadiness and without the intervention of storage batteries.

The method of starting a gas or gasoline engine in the smaller sizes is (after heating up the tube where used, which takes a few minutes) to give the fly wheels a couple of turns by hand. This draws in a charge, compresses and fires it, after which the engine automatically performs its functions. In the larger sizes a so-called self-starter is used, consisting of a small hand air compressor fixed to the side of the engine bed, and a percussion arrangement by which a match or cap gives the spark. The air compressor draws its supply through a small gasoline holder filled with cotton wick and forces a mixture of air and gasoline into the cylinder clearance, the piston being held in place with the crank just above the centre. After a pressure of 20 or 30 lbs. has been reached the match or cap is ignited by the sudden action of a small plunger and the gaseous mixture fired. The air expansion thus brought about causes the engine to take a few rapid revolutions, which suffice to start it. In some cases the engine pumps air under pressure into a tank when working, and this compressed air is used to start the engine when necessary.

The cooling of the cylinder and adjacent parts is effected, as before stated, by circulating water through the jackets provided for the purpose. The water supply is in most cases a sheet metal or wooden tank, with connections at top and bottom. The water in this tank is kept just above the level of the upper connection, and as the cylinder of the engine heats up, a circulation is established through the connecting pipes and tanks. The amount of water required is very trifling. It has been found that the best economy is obtained when the cooling water is kept near the boiling point and tanks are proportioned with that end in view. Where convenient, water under pressure is used for cooling, dispensing with tanks, and sometimes a pump on the engine draws cooling water from a well or convenient stream. The noise made by the exhaust has proved a difficult problem to tackle, as a contrivance whtch effectually quiets the noise of the exhaust also sets up back pressure and consequent loss of efficiency. The various experiments in this direction have finally sifted down to the plain muffler pot, a plain cast iron covered pot with two openings in the top threaded to receive the exhaust pipes. The purpose of this contrivance is to allow the exhaust to expand where it will make the least noise, and the muffler pot fairly effects its purpose.

Measurement of power in a gas or gasoline engine is practically identical with that in a steam engine, as in both the indicator affords a diagram which exhibits the necessary data. In a gas or gasoline engine, however, as the power is applied only every fourth stroke, and the engine is single acting, only one-fourth of the total piston speed can be considered in the computation.

It will be noted that the power of a gasoline engine is affected by two factors only, namely, cylinder area and piston speed, unlike the steam engine in which the factors are cylinder area, piston speed and the varying pressure of the steam. In the gasoline engine the mean effective pressure is practically constant, as it is produced by the combustion of gases whose volume and constituents are practically identical in each charge. It follows, therefore, that a gasoline engine should be rated for the market at its brake or actual horse power, and this is done in the case of most engines. The customer who buys a 12 h.p. gasoline engine gets an engine which will develop that power and a percentage over when running at a proper speed, and the facts are guaranteed by the maker. The only way in which the power of the engine can be increased is by speeding it up, so the engine should always be of ample power for the total load. On the other hand, too large an engine should not be chosen, as engines run under power show a marked decrease in efficiency. Experiments with a 12 h.p. gas engine show a consumption of 15 cubic feet of gas per horse power per hour at full load, 15½ at 10 h.p., 16½ at 87 h.p., 18 at 6 h.p., 21 at 4 h.p., and 30 at 2 h.p.

The different applications of the gasoline engine are numerous and interesting. The marine engine, for instance, has so many advantages over the steam engine, particularly for small boats, that as it is perfected it must eventually take first place in this direction. It has no boiler throws off, no heat, needs no firing, and needs a mimimum of attention, besides being compact and clean

in a marked degree. The marine gasoline engine is not reversible, but a reversible propeller, or a reverse gear mechanism is used. This latter is the well known "Jack in the Box" arrangement and works perfectly. The exhaust is carried overboard under water and is absolutely noiseless; a small pump supplies the cooling water, and the gasoline tank is placed generally in the bow. The Otto or 4 cycle type is growing into popular favor very rapidly, as it is more economical than the two cycle engine, and is perfectly safe because it uses the gasoline in liquid form, while the two cycle engine uses a carburetter or gas-making appliance and thus offers opportunity for explosions. The two stroke cycle engine is so called because it completes its cycle in one revolution. The upward stroke of the piston draws a charge of carburetted air into the base of engine through a check valve, which, on the downward stroke, is partially compressed and forced into the cylinder, where it is fired. The upward stroke, which draws the charge into the base, also completes the compression of the charge in the cylinder. The exhaust takes place through a port uncovered by the piston at the end of its down stroke. Electric ignition is generally used in marine work. The automobile seemed at one time to offer a large field for the hydro-carbon motor, but in my opinion the steam engine and boiler in a refined form offers the best solution of the problem. The gasoline engine is troublesome to start and must be kept constantly in motion. The speed of a gasoline engine cannot be varied to the extent necessary in carriage work, without great complication, and cannot be reversed without introducing the same objectionable feature; while the steam engine has an infinite variety of speeds, its reversal is easily arranged and it will start at the touch of a lever. The engines used for the purpose are beautiful refinements of the ordinary steam engine with tubular frames, steel cylinders and working parts—they are usually twin cylinder engines. The boilers are copper pipe boilers fired by gasoline, and entirely automatic as to firing, steam and water regulations.

The gasoline engine finds a broad field, however, for mining, agriculture and other purposes, and new uses are being found for it continually.

## PRODUCTS OF COAL.

The monthly open meeting of the Hamilton branch of Stationary Engineers was held on Tuesday, February 20th. The principal event of the evening was an address by Mr. J. M. Williams, of J. Winer & Co., on the subject of products that could be obtained from coal. The address was illustrated throughout by means of blackboard drawings, and specimens of the various substances named were on exhibition for the inspection of the members present.

It was demonstrated that after the first product, which was heat, the next two of greatest importance were gas and coke. From the coke we obtain electric light carbons and carbide of calcium used in the production of acetylene gas. Coal tar was the next production, and as the substances obtained from the distillation of this tar are practically innumerable, the principal products only were touched on.

We first obtain from coal tar a substance called benzol, which, combined with nitric acid, forms nitro-benzol, which is used extensively in the art of perfuming soap. Next we produce carbolic acid, then creosote, a substance used for preserving railway ties, wharves, etc. Then follows napthaline, used in the manufacture of camphor balls; in exceptionally cold temperature this substance sometimes blocks up the gas pipes. We then obtain solid paraffins, principally in the form of waxes. The last product obtained through the distilling process of coal tar is pitch.

It was then shown how the articles and productions mentioned were applied to the manufacture of modern commodities of everyday use. The explosives used in modern warefare are composed largely of materials obtained from coal, such as carbolic acid, etc.; napthaline goes into some of them and is used in some of the cartridges of the present day. The speaker exhibited samples of cordite and other explosives, and explained how smokeless powder differed from ordinary gun-powder. It was shown how natural articles of commerce were being imitated by productions from coal tar, such as oil of wintergreen, obtained from carbolic acid; musk; saccharine, which is 500 times sweeter than common sugar; and also artificial perfume resembling flower of lilac. In cases of sickness saccharine can sometimes be used where sugar could not. Gum-benzoic, naturally obtained from the juice of a tree grown in eastern countries, a substance which has been used from earliest times in making insense, and in all probability utilized in the preservation of mummies, is now artificially made in the form of benzoic acid. Mr. Williams had on exhibition a piece of gum-benzoic which was over two hundred years old. A substance is also obtained from coal tar which is practically the same as quinine.

At the conclusion of the address a hearty vote of thanks was tendered Mr. Williams for his trouble in preparing such an interesting and exhaustive address on the subject. Mr. L. B. Mann, of Boston, one of the prominent stationery engineers on the other side, addressed the meeting before it closed, and announced that he would be present at some meeting in the near future and address the members at some length. Mr. H. J. Wickens, of Toronto, made a few remarks, and a paper from him on "Electricity" is looked for in the near future.

## CONDENSER CAPACITIES.

Mr. A. Aller, writing in Power, gives the accompanying table showing in cubic feet the quantity of condensing water required per minute, concerning which he says: This table enables any engineer to easily determine the condensing water required for a steam engine or steam pump. For instance, if the condenser is required for an engine, say diameter of piston 20 inches, length of stroke 48 inches, speed of piston 600 feet, cut-off 1/4, initial steam pressure 80 pounds, by referring to table, 20 inches diameter of piston at 80 pounds steam pressure, for 100 feet of piston speed per minute at full stroke requiries 19.4 cubic feet of water per minute, and at 600 feet piston speed would be 116.4 cubic feet, and when divided by 1/4 stroke would equal 29.1 cubic feet of water, or 218 gallons of condensing water per minute, and when condenser is required for pump it is necessary to know how many gallons of water is discharged regularly by pump at a given pressure. For instance: If pump is discharging 500 gallons per minute against 100 pounds pressure or 230 feet head. As one horse power is required for every 2,500 gallons of water elevated one foot high per minute, 500 gallons of water elevated 230 feet high would require 46 horse power. Thus by this simple table the quantity of condensing water required is easily ascertained, as this table is applicable for any style of condenser used for steam engines or steam pumps. You will notice on table in left hand column the horse power gained for every 100 feet of piston speed per minute.

QUANTITY OF CONDENSING WATER REQUIRED PER MINUTE IN CUBIC FEET

For Every Hundred Feet of Piston Speed per Minute. Steam Pressure in Pounds.

| Horse-power gained for every 100 feet Piston speed per min. | Diameter of Piston in Inches | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 110 | 120 | 130 | 140 | 150 | Diameter of Piston in Inches |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.03 | 6 | 0.8 | 0.9 | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 | 2.0 | 2.2 | 2.3 | 2.5 | 2.6 | 2.8 | 6 |
| 1.40 | 7 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.8 | 1.9 | 2.0 | 2.1 | 2.2 | 2.3 | 2.4 | 2.6 | 2.7 | 2.8 | 3.0 | 3.2 | 3.4 | 3.6 | 3.8 | 7 |
| 1.83 | 8 | 1.5 | 1.7 | 1.9 | 2.0 | 2.1 | 2.3 | 2.5 | 2.6 | 2.8 | 2.9 | 3.1 | 3.2 | 3.4 | 3.5 | 3.6 | 3.9 | 4.2 | 4.5 | 4.7 | 5.0 | 8 |
| 2.31 | 9 | 1.9 | 2.1 | 2.3 | 2.5 | 2.7 | 2.9 | 3.1 | 3.3 | 3.5 | 3.7 | 3.9 | 4.1 | 4.2 | 4.4 | 4.6 | 5.0 | 5.3 | 5.7 | 6.0 | 6.3 | 9 |
| 2.86 | 10 | 2.4 | 2.6 | 2.9 | 3.1 | 3.4 | 3.6 | 3.9 | 4.1 | 4.4 | 4.6 | 4.8 | 5.0 | 5.2 | 5.5 | 5.7 | 6.2 | 6.6 | 7.0 | 7.4 | 7.8 | 10 |
| 3.43 | 11 | 2.9 | 3.2 | 3.5 | 3.8 | 4.1 | 4.4 | 4.7 | 5.0 | 5.3 | 5.6 | 5.9 | 6.1 | 6.4 | 6.7 | 6.9 | 7.5 | 8.0 | 8.5 | 9.0 | 9.5 | 11 |
| 4.11 | 12 | 3.5 | 3.8 | 4.2 | 4.5 | 4.9 | 5.2 | 5.6 | 5.9 | 6.3 | 6.6 | 7.0 | 7.3 | 7.6 | 7.9 | 8.3 | 8.9 | 9.5 | 10.1 | 10.7 | 11.3 | 12 |
| 4.85 | 13 | 4.1 | 4.5 | 5.0 | 5.3 | 5.8 | 6.2 | 6.5 | 7.0 | 7.4 | 7.8 | 8.2 | 8.6 | 8.9 | 9.3 | 9.7 | 10.4 | 11.2 | 11.9 | 12.6 | 13.3 | 13 |
| 5.60 | 14 | 4.7 | 5.2 | 5.7 | 6.2 | 6.7 | 7.2 | 7.7 | 8.1 | 8.6 | 9.0 | 9.5 | 9.9 | 10.4 | 10.8 | 11.3 | 12.1 | 13.0 | 13.8 | 14.6 | 15.4 | 14 |
| 6.46 | 15 | 5.4 | 6.0 | 6.7 | 7.1 | 7.7 | 8.2 | 8.8 | 9.3 | 9.9 | 10.4 | 10.9 | 11.4 | 11.9 | 12.4 | 12.9 | 13.9 | 14.9 | 15.8 | 16.8 | 17.7 | 15 |
| 7.31 | 16 | 6.6 | 6.8 | 7.5 | 8.1 | 8.7 | 9.4 | 10.0 | 10.6 | 11.2 | 11.8 | 12.4 | 13.0 | 13.6 | 14.2 | 14.7 | 15.9 | 16.9 | 18.0 | 19.1 | 20.2 | 16 |
| 8.28 | 17 | 7.0 | 7.7 | 8.4 | 9.2 | 9.9 | 10.6 | 11.3 | 12.0 | 12.7 | 13.3 | 14.0 | 14.7 | 15.3 | 16.0 | 16.6 | 17.9 | 19.1 | 20.4 | 21.6 | 22.8 | 17 |
| 9.25 | 18 | 7.8 | 8.6 | 9.5 | 10.3 | 11.1 | 11.9 | 12.6 | 13.4 | 14.1 | 15.0 | 15.7 | 16.5 | 17.2 | 17.9 | 18.7 | 20.1 | 21.5 | 22.8 | 24.2 | 25.5 | 18 |
| 10.34 | 19 | 8.7 | 9.6 | 10.6 | 11.4 | 12.3 | 13.2 | 14.1 | 15.0 | 15.8 | 16.7 | 17.5 | 18.3 | 19.2 | 20.0 | 20.8 | 22.4 | 23.9 | 25.5 | 27.0 | 28.4 | 19 |
| 11.42 | 20 | 9.7 | 10.7 | 11.7 | 12.7 | 13.7 | 14.7 | 15.6 | 16.6 | 17.6 | 18.5 | 19.4 | 20.3 | 21.2 | 22.1 | 23.0 | 24.8 | 26.5 | 28.2 | 29.9 | 31.5 | 20 |
| 13.82 | 22 | 11.7 | 12.9 | 14.2 | 15.4 | 16.6 | 17.7 | 18.9 | 20.1 | 21.2 | 22.4 | 23.5 | 24.6 | 25.7 | 26.8 | 27.9 | 30.0 | 32.1 | 34.1 | 36.2 | 38.1 | 22 |
| 16.45 | 24 | 13.9 | 15.4 | 16.8 | 18.3 | 19.7 | 21.1 | 22.5 | 23.9 | 25.2 | 26.6 | 28.0 | 29.3 | 30.6 | 31.9 | 33.2 | 35.7 | 38.2 | 40.6 | 43.0 | 45.4 | 24 |
| 19.30 | 26 | 16.4 | 18.1 | 19.8 | 21.5 | 23.1 | 24.8 | 26.4 | 28.0 | 29.6 | 31.2 | 32.8 | 34.4 | 35.9 | 37.4 | 39.0 | 41.9 | 44.8 | 47.7 | 50.5 | 53.3 | 26 |
| 22.39 | 28 | 19.0 | 21.0 | 23.0 | 24.9 | 26.8 | 28.8 | 30.7 | 32.5 | 34.4 | 36.2 | 38.1 | 39.9 | 41.6 | 43.4 | 45.2 | 48.6 | 52.0 | 55.3 | 58.6 | 61.8 | 28 |
| 25.70 | 30 | 21.8 | 24.1 | 26.4 | 28.6 | 30.8 | 33.0 | 35.2 | 37.3 | 39.5 | 41.6 | 43.7 | 45.3 | 47.8 | 49.9 | 51.9 | 55.8 | 59.7 | 63.5 | 67.3 | 71.0 | 30 |
| 29.24 | 32 | 24.8 | 27.4 | 30.0 | 32.6 | 35.1 | 37.6 | 40.1 | 42.5 | 44.9 | 47.3 | 49.7 | 52.1 | 54.4 | 56.7 | 59.1 | 63.5 | 67.9 | 72.3 | 76.5 | 80.8 | 32 |
| 33.01 | 34 | 28.0 | 31.0 | 33.9 | 36.8 | 39.6 | 42.5 | 45.2 | 48.0 | 50.7 | 53.5 | 56.1 | 58.8 | 61.4 | 64.1 | 66.7 | 71.7 | 76.7 | 81.6 | 86.4 | 91.2 | 34 |
| 37.01 | 36 | 31.4 | 34.7 | 38.0 | 41.2 | 44.4 | 47.6 | 50.7 | 53.8 | 56.9 | 59.9 | 63.0 | 65.9 | 68.9 | 71.8 | 74.8 | 80.4 | 86.0 | 91.5 | 96.0 | 102.2 | 36 |
| 41.24 | 38 | 35.0 | 38.7 | 42.3 | 45.9 | 49.5 | 53.0 | 56.5 | 59.9 | 63.4 | 66.8 | 70.1 | 73.5 | 76.7 | 80.0 | 83.3 | 89.6 | 95.8 | 102.0 | 108.0 | 113.9 | 38 |
| 45.70 | 40 | 38.8 | 42.9 | 46.9 | 50.9 | 54.8 | 58.8 | 62.6 | 66.4 | 70.2 | 74.0 | 77.7 | 81.4 | 85.0 | 88.7 | 92.3 | 99.3 | 106.2 | 113.0 | 119.6 | 126.2 | 40 |
| 50.38 | 42 | 42.8 | 47.3 | 51.7 | 56.1 | 60.5 | 64.8 | 69.0 | 73.2 | 77.4 | 81.6 | 85.7 | 89.8 | 93.8 | 97.8 | 101.8 | 109.5 | 117.1 | 124.6 | 131.9 | 139.1 | 42 |
| 55.29 | 44 | 47.0 | 51.9 | 56.8 | 61.6 | 66.4 | 71.1 | 75.8 | 80.4 | 85.0 | 89.6 | 94.1 | 98.5 | 102.9 | 107.3 | 111.7 | 120.2 | 128.5 | 136.7 | 144.7 | 152.7 | 44 |
| 60.43 | 46 | 51.3 | 56.7 | 62.1 | 67.3 | 72.5 | 77.7 | 82.8 | 87.9 | 92.9 | 97.9 | 102.8 | 107.7 | 112.5 | 117.3 | 122.1 | 131.3 | 140.4 | 149.4 | 158.2 | 166.9 | 46 |
| 65.80 | 48 | 55.9 | 61.8 | 67.6 | 73.3 | 79.0 | 84.6 | 90.2 | 95.7 | 101.2 | 106.6 | 112.0 | 117.3 | 122.5 | 127.7 | 133.0 | 143.0 | 152.9 | 162.7 | 172.3 | 181.8 | 48 |
| 71.40 | 50 | 60.7 | 67.0 | 73.3 | 79.5 | 85.7 | 91.8 | 97.9 | 103.8 | 109.8 | 115.7 | 121.5 | 127.2 | 132.9 | 138.6 | 144.3 | 155.2 | 165.9 | 176.6 | 186.9 | 197.2 | 50 |

The officers and members of the Montreal Association of Stationary Engineers recently presented Mr. J. J. York, mechanical superintendent of the Canada Sugar Refining Co., with a handsome silver tea set and tray, appropriately engraved. The presentation was made by Mr. Thos. Ryan, and was intended as a small token of recognition for the efficient services rendered by him as president of the association. The members were afterwards invited to a sumptuous repast at Mr. York's residence.

## INTERIOR CONDUITS.

When interior conduit was first placed upon the market, its reception was by no means an enthusiastic one. There seemed to be a strong prejudice against that mode of wiring, and it was thought unnecessary and objectionable by many electrical engineers. The Interior Conduit and Insulation Company, which has since been absorbed by The Sprague Electric Co., was, however, convinced of the necessity for better methods of wiring than had existed up to that time, and perseveringly demonstrated beyond all doubt the desirability and necessity of such a system. From its first step in offering to the public unarmored asphaltic paper conduit, this company claim to have met all the varying conditions imposed by the rapid improvement in the art of modern building construction. The introduction of unarmored conduit was followed by that of brass armored, and later by iron armored. Its latest product is the flexible metallic conduit, now made in all sizes and possessing many features of excellence. A few of the many advantages claimed for this conduit are: By reason of its great flexibility as well as its perfectly smooth and almost frictionless interior, it is entirely feasible to string it over beams and around comparatively sharp constructions, equivalent to many more elbows than might be used in the rigid pipe system in the same situation, and yet retain the wire freedom so essential to drawing in or withdrawing.

The design of the conduit is such that while affording the greatest ease in bending to a curve formation, it absolutely prevents the possibility of flattening. The interior is thus invariably of uniform diameter and symmetrical proportions.

The surface presented to the insulation of a conductor in "drawing in" is less than 20 per cent. of its entire length, while that portion of the insulation in actual contact with the conduit after it has settled to its position can never exceed 25 per cent. of the whole, leaving the balance practically suspended in free air.

Another important feature of the construction of this conduit that will appeal especially to architects and builders is that the outer surface is such that plaster or other surfacing material will rigidly adhere to it, thereby entirely eliminating the unsightly "plaster cracks" so frequently in evidence where rigid conduit has been covered by a comparatively thin layer or "skim coat."

It is generally admitted that the best wire insulations require either to be kept dry or to be completely and continuously immersed in water. Since to effect the latter is impracticable, the problem is to achieve the former as nearly as is consistent with practical methods. It is well known that condensation or "sweating" takes place with great freedom in unlined metal pipes, and also that the water so condensed will be retained within a pipe system indefinitely, resulting in keeping the wires moist without completely submerging them, thus absolutely guaranteeing the ultimate destruction of their insulation. Now, were the same pipe thoroughly ventilated throughout every unit of its length and its diameter, it is apparent that the products of condensation would not be retained. In fact, there would not be any condensation.

Flexible metallic conduit is just such a ventilated pipe; by reason of its spiral formation there is no unit of its length or of its diameter without its vent. Wires placed in such a conduit are of necessity maintained in a condition as free from moisture as is physically possible short of hermetically sealing them, which, as is now known from long experience, is practically impossible.

The destructive action of a short circuit in unlined rigid tube is too well understood by electrical engineers and others to require extended discussion here; it has been demonstrated, however, by actual experiment, that such destruction cannot occur in the flexible metallic conduit on account of its perfect ventilation, which allows the energy of a "short circuit" to be dissipated throughout every unit of the conduit section in which it develops, leaving the interior of the conduit as perfect as before the occurence of the "short circuit."

Experiments with nails, hammers, saws and other tools have clearly demonstrated that flexible metallic conduit has mechanical strength superior to commercial gas pipe of the same wall thickness and of approximately the same interior diameter, therefore as a satisfactory protecting envelope for insulated conductors it is more desirable than any form of conduit at present manufactured; the formation of the outer metal ribbon presenting an almost impenetrable surface to nails, etc.

The tools required for installing Greenfield flexible conduit are few and simple. An adjustable vise is provided for holding the tube while it is cut with an ordinary hack saw. A reaming tool, similar to that used with iron pipes, removes the slight burr caused by the saw.

An additional protection against any possible injury to insulation while the wire is being drawn in, is provided by a small, soft metal bushing which is inserted in the end of the tube and secured permanently by an expanding tool. When the bushing is inserted in the end and the expanding tool applied by a strong pressure of the hand it forces the metal into the spiral formation of the tube, making a smooth and frictionless finish to the end.

The National Underwriters Association has decided that conductors used in this conduit should have insulation equal to that required for conductors installed in uninsulated metal conduit, as shown in their Rule No. 40, Class D, and that the conduit will be approved under the same conditions imposed by them on any other uninsulated pipe.

As it is manufactured in lengths of 100 feet, and as the circuit divisions in interior wiring rarely exceed that distance, it follows that no necessity exists for a break in the continuity of a division from junction box to outlet. But the great gain is in the saving of time, labor and cost of construction, as it is obvious that there are no elbows with their diminished cross section, no threads to cut, and consequently no burden of tools to constitute a workman's equipment. Again, while many contractors have thought on account of its many advantages that it was more expensive than the plain rigid iron pipe, this is quite a misconception, as in addition to the saving it effects in elbows, and couplings, and labor in installation, the conduit itself is somewhat cheaper. The use of this conduit therefore solves the problem of rendering an uninsulated "plain" metal conduit thoroughly reliable, safe, and in all respects a satisfactory protecting envelope for the insulated wire it encloses.

The Sprague Company still maintains its position as the pioneer in this department of electrical fields. All its manufactures are approved by the National Board of Fire Underwriters, and may therefore without hesitation be recommended for every kind of interior wiring.

Persons interested may obtain further particulars or catalogues from the Canadian sales agents, Messrs. Jack & Robertson, 7 St. Helen St., Montreal.

## MOONLIGHT SCHEDULE FOR MARCH.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | P.M. 6.20 | A.M. 5.40 | 11.20 |
| 2.... | " 6.20 | " 5.40 | 11.20 |
| 3.... | " 6.20 | " 5.40 | 11.20 |
| 4.... | " 9.00 | " 5.30 | 8.30 |
| 5.... | " 10.20 | " 5.30 | 7.10 |
| 6.... | " 11.30 | " 5.30 | 6.00 |
| 8.... | A.M. 12.20 | " 5.30 | 5.10 |
| 9.... | " 1.10 | " 5.20 | 4.10 |
| 10.... | " 2.00 | " 5.20 | 3.20 |
| 11.... | " 2.30 | " 5.20 | 2.50 |
| 12.... | " 3.00 | " 5.20 | 2.20 |
| 13.... | " 3.20 | " 5.20 | 2.00 |
| 14.... | No Light. | No Light. | ..... |
| 15.... | No Light. | No Light. | ..... |
| 16.... | No Light. | No Light. | ..... |
| 17 ... | P.M. 6.40 | P.M. 9.00 | 2.20 |
| 18.... | " 6.40 | " 9.45 | 3.05 |
| 19.... | " 6.40 | " 10.45 | 4.05 |
| 20.... | " 6.40 | " 11.45 | 5.05 |
| 21.... | " 6.40 | A.M. 12.40 | 6.00 |
| 22.... | " 6.40 | " 1.40 | 7.00 |
| 23.... | " 6.40 | " 2.30 | 7.50 |
| 24.... | " 6.40 | " 3.20 | 8.35 |
| 25 ... | " 6.50 | " 4.00 | 9.10 |
| 26.... | " 6.50 | " 4.40 | 9.40 |
| 27.... | " 6.50 | " 5.00 | 10.40 |
| 28.... | " 6.50 | " 5.00 | 10.10 |
| 29.... | " 6.50 | " 5.00 | 10.10 |
| 30.... | " 6.50 | " 5.00 | 10.10 |
| 31.... | " 6.50 | " 4.50 | 10.00 |
| | | Total......... | 189.00 |

The owners of the Velvet Mine in British Columbia purpose constructing a railway from Rossland to the mine. It is probable that electricity will be the motive power. Upon this point a director of the British Electric Co. will shortly make a report to the owners.

## SPARKS.

The Louisburg Electric Water and Power Co., of Louisburg, C. B., is seeking incorporation.

The Lay Whip Co., of Rock Island, Que., intend erecting a new factory, to be operated by steam power.

The Montreal Street Railway Co. have fitted up club rooms for their men at the corner of Cote and Vitre streets.

The two companies applying for charters to build an electric railway from Ottawa through the Winchester district to a point on the St. Lawrence river have amalgamated.

Mr. W. T. Stewart, electrical engineer, of Toronto, has been engaged to prepare an estimate of the cost of a system of street and commercial lighting for Toronto Junction, Ont.

Negotiations are said to be in progress for the location at Brantford, Ont., of a well known firm of manufacturers of electrical apparatus, whose headquarters are in the United States.

The electric light plant at Huttonville, Ont., was completely destroyed by fire on February 15th. The plant was used for lighting the town of Brampton, four miles distant, and was insured for $3,000.

A gentleman has made a proposition to the town council of Collingwood, Ont., to establish smelting works and rolling mills there. He agrees to expend $1,300,000 on the plant. It is his intention to utilize the blast furnace gases for the production of power to operate the blowing engine and electric plant that will be installed for driving the machinery.

Mr. Clyde K. Green has entered upon his duties as traffic manager of the electric railway system of the Cataract Power Co., of Hamilton, and Mr. J. B. Griffith, late manager of the Hamilton street railway, has been installed as purchasing agent of the syndicate. Mr. H. R. Leydon has successed Mr. Gordon J. Henderson as manager of the Hamilton Electric Light & Power Co., and Mr. Henderson will be appointed to another position in onnection with the company's plant.

The annual meeting of the Halifal Electric Tramway Co., Limited, was held at Halifax on February 12th. The statement of the directors showed a net profit of $61,798, as compared with $54,748.54 for the previous year. The percentage of operating expenses was reported to be lower than in any previous year, showing a decrease of 3.91 per cent. as compared with 1898. The car mileage increased during the year by 20,334 car miles, and 2,616,231 passengers were carried, an increase of 196,963 over the previous year. The total instalment of incandescent lamps throughout the city was given as 17,267. The power station equipment was increased by a constant current alterating arc lamp transformer of 100 lamps capacity, a line transformer of 50,000 capacity, and 110 meters. Mechanical stokers were placed under one boiler.

Messrs. Wright & McKinley, of Seaforth, Ont., are still negotiating with Dr. Norton for the purchase of the electric light plant at Shelburne. If an agreement is reached they agree to supply lights at the following rates on a five year contract: For lighting streets from dusk until midnight, and eleven o'clock on Sundays, with 26 arc lamps, run on moonlight schedule, $500; for lighting town hall and public library with 20 incandescent lights of 16 candle power, $25. Rates to private takers would be: 1 to 3 lights, 16 c.p., 40c. a month; 4 to 10 lights, 16 c.p., 35c a month; 11 to 15 lights, 16 c.p., 33c a month; over 15 lights, 16 c. p., 30c. a month. Bed room lamps, 8 c. p., $2 per year; 10 c.p., $2.25 per year; 16 c. p., $2.77 per year. Halls and churches, $1.50 per 16 c. p. per year. Cleat wiring, $1 per lamp. Concealed wiring, $1.25 per lamp.

## SPARKS.

The Victoria Telephone Co., of Woodville, Ont., at a recent meeting, decided to extend their line to Lindsay.

The British Columbia Electric Railway Co. intend to do considerable double-tracking in the city of Victoria.

It is said that the Montreal Street Railway Co. have decided to provide special cars for the convenience of smokers.

A new building will be erected in Montreal for the Canadian Pacific Telegraphs, the plans for which are now being prepared by Maxwell & Shuttuck, architects.

The town council of Richmond, Que., have given a five year contract for street lighting to the electric lighting company of that place, at the price of $1,000 per year.

The corporation of the village of Beaurivage, Que., is seeking power from the Quebec Legislature to construct an electric railway within the municipality and connecting with the city of Montreal.

Messrs. Peter Ryan and John Shields, of Toronto, have submitted to the council of Kamloops, B.C., a proposition to establish electric light and waterworks systems costing $100,000, provided they are given a franchise for thirty years.

The transport "Milwaukee," which was chartered to carry the Canadian cavalry to South Africa, was fitted with electric lights. The installation includes a 10 k.w. multipolar dynamo and switchboard, which is being supplied by the Royal Electric Co. This is the second transport for which this company have supplied the electrical apparatus.

## SPARKS.

The village council of East Toronto is looking into the question of installing an electric light plant.

Various sites have been visited by the city council of Halifax, N.S., which has decided to establish a municipal electric light plant.

The United Electric Co., of Toronto, purpose erecting new factory buildings, increased business having made larger works necessary.

A by-law will likely be submitted to the ratepayers of Yarmouth, N. S., to provide the sum of $13,000 for a steam pumping plant for the waterworks system.

Messrs. W. A. McLean, D. Robertson and others have been incorporated as the Walkerton Electric Light & Power Company, of Walkerton, Ont., with a capital of $30,000.

It is stated that the Dominion government has decided to install a storage battery plant at Hamilton beach, and to light the piers and approaches to the canal by electricity.

A very attractive booklet descriptive of the Lundell motor has been received from Messrs. Jack & Robertson, of Montreal, Canadian agents for the Sprague Electric Company.

The Canadian General Electric Company are in need of additional factory accommodation, and it is probable that they will erect a large addition to their works at Peterboro, Ont.

The E. B. Eddy Co., of Hull, Que., have awarded the contract for electric motors for operating their factory in Hull to Ahearn & Soper, Canadian agents for the Westinghouse Company.

The mayor of Winnepeg has announced that he will introduce a by-law to provide $300,000 for the installation of a municipal gas plant, also that he will take steps to secure the franchise for private electric lighting.

The Crow's Nest Pass Electric Light and Power Co. has been incorporated by the Government of British Columbia. It is proposed to develop water powers and supply electric light and power to the town of Fernie and vicinity.

Some idea may be gained of the output of the Goldie & McCulloch Co., Limited, of Galt, Ont., when it is known that they sold 34 engines the first 47 days of the present year. They are busy is all their other departments as well.

Messrs. W. B. Snowball, R. A. Snowball, Geo. E. Fisher, R.A. Lawlor and D. G. Smith are seeking incorporation as the Chatham Electric Light Co., capital $50,000, to carry on an electric lighting business in the vicinity of Chatham, N. B.

Mr. M. Kyle, of Rat Portage, Ont., when in Toronto recently, stated that as soon as the mines of the Gold Panner Mining Company were established on a firm basis, a water power would be utilized and the entire plant operated by electricity.

One for the New Midland Elevator Co., one for the Beaver Portland Cement Company, Marlbank, and three for the Linde British Refrigerator Co., of Montreal, are among recent sales of Wheelock engines made by the Goldie & McCulloch Co., Limited, Galt, Ont.

The C.P.R. Telegraph Company have decided to purchase the building now occupied at the corner of Hospital and St. Francois-Xavier streets, Montreal, and in the spring to erect on the site thereof a new building so planned as to meet the requirements of their rapidly growing business.

A committee of the council of St. Mary's, Ont., visited the towns of Goderich and Seaforth to secure information regarding the operation of waterworks and electric light plants. This committee has recommended that the rown assume control of all private electric lighting and that additions be made to the plant.

Among recent sales this year of Ideal high speed engines made by the Goldie & McCulloch Co., Limited, of Galt, is one for St. Francois-Xavier College, Antigonish, N. S., two for Canadian General Electric Company, and one for Wm. Cowan & Co., Prince Albert, N. W. T. These engines are in demand all over the Dominion, as the above orders show.

The T. Eaton Company have decided to remove their entire engineering department from its present location in the main building to a new building recently erected on the north side of Albert st., Toronto. As this is one of the largest isolated electric and steam plants in the Dominion, this change will involve a vast amount of labor. The chief engineer of this plant is Mr. E. J. Philips.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURAL.

VOL. X. APRIL, 1900 No. 4.

## A MAMMOTH LEATHER BELT.

THE illustration on this page represents the largest leather belt ever made in Canada. It was manufactured by Messrs. Sadler & Haworth, of Montreal and Toronto, for the Ogilvie Milling Company, of Winnipeg, Man. Its dimensions are: Width, 72 inches; length, 115 feet; thickness, 3 ply; while its total weight is 2,270 lbs. The same firm recently furnished two 48 inch 3 ply belts for the Standard Electric Company of Montreal, a 38 inch belt for the London Electric Light Company, and several wide 3 ply belts for saw mills.


THE LARGEST LEATHER BELT EVER MADE IN CANADA—FROM THE FACTORY OF SADLER & HAWORTH.

## GAS DRIVEN ELECTRIC PLANT.

AN interesting feature of the public service of Zurich and the neighborhood is the power plant at Oerliken, which furnishes current for the street railway lines. The installation at present includes one gas generator of 200 horse power and two of 100 hundred horse power. The generators burn anthracite from the Liege district. The gas is washed and passes through coke scrubbers and saw-dust. No smell of tar is noticed, and no trouble seems to arise in the engines, which, like the generators, come from the Maschinenfabrik Deutz. The three engines of 125 horse-power drive, each, a compound four-pole continuous current generator for 550 volts at 180 revolutions. A battery of 280 Tudor cells is connected in parallel to the dynamos. Tne regulating cells are changed by a motor-generator.

The guide book furnishes the following information regarding this station, which belongs to the Zurich Oerliken-Seebach system: Coal consumed per effective horse power of the gas engines, 0.65 kilogramme (1.4 lb.); each train makes 161 kilometers (100 miles) per day; the line having a length of 5 miles and a rolling stock of 20 cars, of which, as a rule, only 10 are running. With 3.2 passengres per car-kilometer, the income is 43 centimes per car-kilometer, and the cost amounts to 34.4 centimes.

## ELECTRICAL EQUIPMENT OF THE HIGHEST OFFICE BUILDING IN THE WORLD.

FIG. 1—EXTERIOR OF PARK ROW OFFICE BUILDING, NEW YORK CITY.

AMONG the forest of lofty structures upon the lower end of Manhattan Island, the Park Row Syndicate Building stands out prominently. This mammoth office building is opposite the New York post office, and adjoins the city hall square, and marks an important centre of the city. The construction of this building, which has recently been completed, offers to the engineer, architect, and builder many points of interest. The most modern developments of art and science in each branch of work have been applied to the equipment, and characterize this building as an advance upon previous structures. The first illustration gives an idea of the number of stories and the consequent immense number of persons to be accommodated and transported. The building is somewhat irregular in plan, having a frontage of 104 feet on Park Row, and extends backward a distance of 178 feet. There are 26 stories from the ground level to the main roof, five stories in each tower, and one small story in each dome. In addition, there is a basement and sub-cellar below ground, making a total of 34 stories in all. The height of the building is 424 feet. Pile foundations are used throughout, the total weight of the building being computed at about 65,000 tons.

The building contains nearly 1,000 offices, each of which is finished in hard wood, is steam heated, electric lighted, and supplied with hot and cold water. All the offices are connected by telephones, with an information bureau at the entrance to the building, and have a messenger call box. It is estimated that the building has accommodation for 4,000 persons, and will contain this number when all the offices are let.

The Westinghouse Electric & Manufacturing Company supplied the electrical equipment, including the generators, boosters and switchboard, an account of which will be given in this article. The other branches of construction were designed and carried out so that the building should be second to none in point of equipment. The boiler room is in the center of the sub-cellar, east of the generating plant, and contains three water tube boilers, aggregating 900 h.p. The main steam pipes are designed to carry a continuous working pressure of 130 pounds to the square inch. Each boiler is provided with separators to insure the delivery of dry steam to the engines. Exhaust fans, operated by electric motors, retain the temperature of the boiler and engine rooms at a low point. From the boiler room steam is taken to heat the system of offices. In zero weather 70 degrees will be maintained by direct low pressure, or exhaust steam radiators, operated by a 16 inch main in the basement. This main is cross-connected with the exhaust from the engine and pumps. The condensation from the heating system is returned to the boilers by pumps.

In the sub-basement the three boilers are installed near the centre, between the columns. The engine and generator room is partitioned off, and in front of these, running under the pavement, is a part used for the storage battery. Coal is brought to the building through an alley and shot into the bunkers. Along one side of the sub-basement a railway track is built for conveying coal from the storage rooms to the boilers, and for carrying ashes to the sidewalk lifts in front of the building.

The engine and generator room contains five steam engines, direct connected to Westinghouse generators. Four of the engines are tandem compound. They are operated as non-condensing compound engines. It is expected that with a steam pressure of 130 pounds they will show a much better steam economy than simple engines. The fifth engine has a single cylinder, and operates a booster in connection with the storage battery.

The electric generating plant was provided by the Westinghouse Electric & Manufacturing Company, and consists of two 200 k.w., one 100 k.w., and one 75 k.w. Westinghouse standard, compound wound generators, 120 volts. Fig. 2 shows one of the 200 k.w. generators. The additional apparatus is the 40 k.w. booster dynamo, direct connected to the smaller engine, and a 20 k.w. booster driven by a 32 h.p. electric motor. Fig. 3 illustrates the booster attached to the electric motor.

In addition to the generating plant, a storage battery has been provided, of 58 chloride accumulators. The battery insures an equalization of load, and acts as a reservoir of electrical energy for supplementing the plant in case of necessity. It also supplies current for a few lights and an elevator service for night duty. The capacity of the cells in the battery is 500 k.w. hours, and the normal discharge rate is 350 amperes for ten hours, but it is capable of discharging at five times this rate, and a momentary discharge of 2,000 amperes for periods not exceeding thirty seconds.

The booster dynamos are operated in connection with the storage battery to compensate and equalize the load fluctuations and to maintain the output of the dynamos relatively constant. The two boosters are interchangeable, to serve for varying outputs, and the dynamo portions are substantially alike. The field of the dynamo portion in both cases has a series and shunt winding, the two connected differentially. Both windings can be varied, the shunt winding being varied by a rheostat in the usual way, while the series winding is varied by a series of equalizer shunts.

The series winding of the booster dynamo is arranged so as to take either the whole or a determinate portion of the current fed from the dynamos into the power circuits, and this winding, and the e.m.f. due to it, are made responsive thereby to the conditions and fluctuations of the load on the power circuits. The shunt windings are connected across the terminals of the battery or excited from the dynamo bus-bars. The armature of the booster dynamo is connected to the battery circuit. By making the proper adjustments so as to regulate the relative effects of the

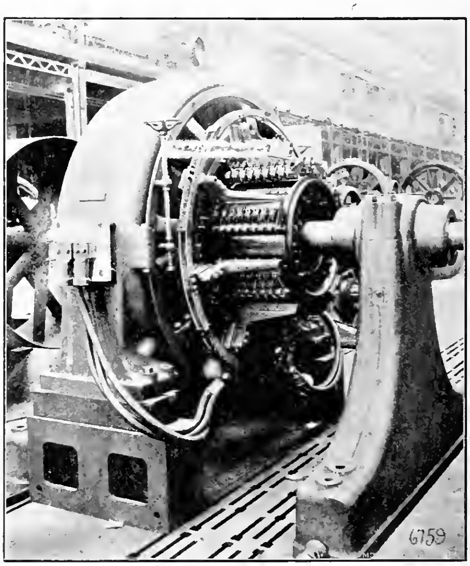



FIG. 2—ONE OF THE TWO 200 K.W. WESTINGHOUSE DIRECT CURRENT, "ENGINE TYPE" GENERATORS.—PARK ROW OFFICE BUILDING, NEW YORK CITY.

series and shunt windings according to the conditions of load, the condition of the charge of the storage battery, and the regulating effect desired, etc., it is possible to arrange the conditions so that for a certain critical current the battery e.m.f. will exactly equal that at the bus-bars. For a higher current the booster dynamo will act as a generator to supplement the e.m.f. of the battery, and make it discharge in parallel with the generators. If the working current falls below the critical value, the effect of the shunt winding predominates, and the booster dynamo will generate an e.m.f. in the opposite direction to supplement the charging effect of the generators. It is seen, therefore, that

when the load increases above the amount for which the adjustments have been made, the booster dynamo will regulate the action of the storage battery so as to make it assist the generators in supplying current, and when the power load becomes light or falls off, the booster will assist the generators in charging the battery.

The critical current admits of a wide range of regulation according to the load curve, the number of generator units that are

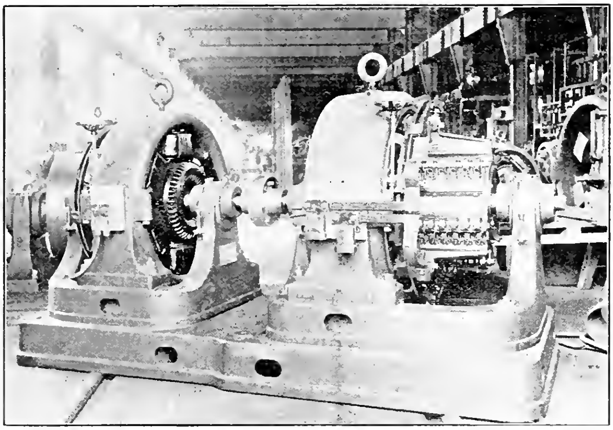


FIG. 3—WESTINGHOUSE 20 K.W. MOTOR DRIVEN BOOSTER.—PARK ROW OFFICE BUILDING, NEW YORK CITY.

in operation, and the condition of the battery, that is to say, whether it is empty or filled, and the rate of charge or discharge which it is desired to maintain. It is intended to keep the battery constantly charged, which can be done by adjusting the relative shunt and series fields. The regulating or compensating action can be obtained with the same ease and precision when the adjustments are such that the battery takes in more than it gives, or is gaining in charge, or when it gives out more than it takes, or is losing in charge.

Recording instruments upon the switchboard show the amount of the charging and discharging, and the station operator is kept advised at all times as to the condition of the storage battery. Current for lighting purposes is taken from the machines beyond the compounding, and the power in connection with the booster and storage battery is taken off within the compounding, by special devices, permitting the compounding effect of the battery to be varied.

The switchboard, shown in Fig. 4, was designed and built by the Westinghouse Electric & Manufacturing Company, from specifications by the electrical engineer. It is in many respects unique, not only in completeness of the appliances, and the facilities which it affords for controlling the operation of the generating plant, but in the thoroughness of the engineering design and workmanship bestowed upon it. It is arranged to control the output of the four 125 volt generators, also for one motor-driven, and one steam-driven booster, and the current from the storage battery. The switchboard has three main divisions. The centre panel serves for the electrica manipulation of all circuits from the main dynamos, booster dynamos, and the storage battery, constituting the electrical generating plant. The right panel serves for lighting feeders only and the left panel for power feeders only. The three panels are side by side, forming one continuous switchboard.

Each generator is provided in its negative circuit with a single pole—fused switch—circuit breaker and an ammeter, while the positive and equalizer circuits pass through a double pole switch, the positive circuit only being fused. One of the 200 k.w. and the 100 k.w. Westinghouse generators are connected to run in multiple, on a separate section of bus-bars at the left end of the dynamo panel facing the front, while the other 200 k.w. generator runs in multiple with the 75 k.w. on a similar section of bus-bars at the right hand end. The boosters, booster motor, and storage battery are connected through their switches to the central section of bus-bars. The central section may be thrown in multiple with either or both of the dynamo sections by means of the heavy three-pole bus-junction switches. If these are left open, the right and left sections of the dynamo panel will be entirely disconnected from the middle section, and the units corresponding to said panels will operate as if they belonged to distinct generating stations, one serving for the lighting current supply and the other for the power current supply. By closing the left "bus-junction switch," the storage battery plant may be coupled, so to speak, to the power side. By closing the right switch it may be coupled to the lighting side, and lastly, by closing both swithes, the two power plants become coupled together in one single generating plant, including the storage battery. This may also be thrown on the bus-bars independently, and the whole generating plant shut down in case of light load, the battery supplying all the necessary current.

The power and lighting sections are each provided with an ammeter, a recording wattmeter and a recording ammeter, for measuring the total current. The lighting section has provision for 48 feeders, 16 of these being 100 amperes and 32 being 200 amperes capacity. They are all provided with double pole fused switches, and 16 of the 200 ampere circuits have circuit breakers in addition. The power section provides for ten 300 ampere and ten 500 ampere circuits, each circuit being supplied with a fused switch and a circuit breaker.

The current from the storage battery is measured by a double reading ammeter, a double reading recording ammeter, and a recording wattmeter, this circuit being also provided with a 500 ampere switch and circuit breaker.

The dynamo panel carries a ground detector, a recording volt-

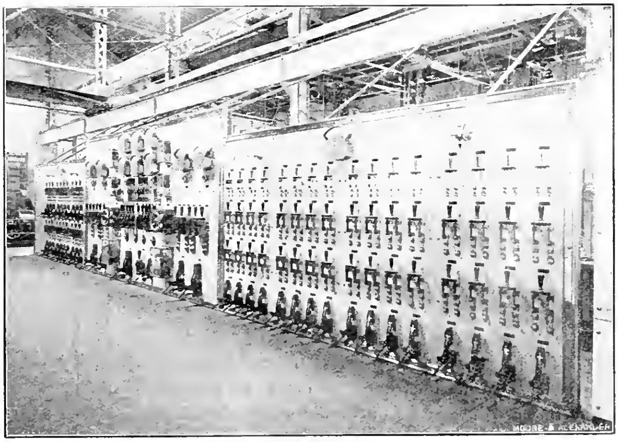


FIG. 4—WESTINGHOUSE SWITCHBOARD, FRONT VIEW. PARK ROW OFFICE BUILDING, NEW YORK CITY.

meter, a differential galvanometer, and a main station voltmeter, each being provided with suitable multipoint switches for connections to the various circuits. There are also ammeters for each booster circuit, and switches for manipulating the boosters and starting the booster motors. All the rheostats are operated by hand-wheels placed on the front of the board.

The board is constructed of the best Tennessee marble of uniform coloring, the separate slabs being joined together by accurately squared edges, presenting the appearance of three arge panels. A rigid angle and channel iron frame supports the

entire board, the whole being carried on iron pedestals, which raise it six inches above the floor. The total length is 42 feet.

The power section at the left end of the switch-board is provided with a marble door, in order that the rear of the board may be conveniently reached from the engine room. The length of the power section is 12 feet, and the height 8 feet above the floor. The length of the dynamo section is 16 feet and the height 9 feet 3 inches. The length of the lighting section is 14 feet, and the height 9 feet 3 inches. An ornamental moulding of bright copper frames each section, and all the instruments, hand-wheels, double goose-necks, instrument cases, and metal trimmings are finished in bright copper. A neat grill work fills the space between the switch-board and ceiling, and hides the pedestals below the board.

Copper-finished engraved name-plates are provided for all instruments and switches, to designate the circuit each operates. All the bus bars and rear connections of the rear of the board are made of the best lake copper, the connections being secured to instrument studs by means of heavy copper nuts screwed on the studs. On account of the complicated nature of the connections the rear of the board presents a perfect network of copper, but the parts are well supported. The individual bars are carefully spaced and symmetrically arranged, and present a very neat appearance, the whole being an excellent piece of switchboard engineering. Indeed, to the careful visiting engineer, the front of the switchboard, handsome as it is, is not as attractive or interesting as the constructive details at the back of it.

The cables for the dynamo leads pass from the board directly into conduits. The feeders for lighting and power rise from the rear of the feeder panels to the ceiling of the dynamo room in conduits. Every part of the board is designed to carry its rated current without appreciable rise in temperature above the surrounding air. The circuit breakers are of a new and novel design, having laminated copper blades, closed with a toggle joint. They break the circuit at the carbon shunts supplied at the top. All the switches are of the unit blade variety. A single unit blade of definite capacity is used. One or two blades are combined in multiple to make up switches of required capacity. All switches are built of the best lake copper, no castings being used in their construction.

The switches and circuit breakers are finished by hand with a good tool finish. The main bus junction switches are of the screw press type, and are 3-pole in order to connect together the positive, negative andequalizer sections of the bus bars. They are constructed on the unit blade principle, each blade being composed of three 1,000 ampere units in multiple, each with its independent set of jaws. The blades move in and out of their jaws by turning a crank handle attached to the hand wheel, and are kept in alignment by suitable suitable guides. The capacity of each of these switches is 3,000 amperes.

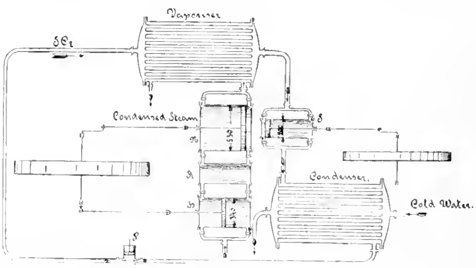
The shunt resistances for varying the compounding of the boosters are constructed of grids ot special resistance metal. They are supported on the rear of the board, near the top, and are suitably connected to the various switches by hard rolled copper bars.

## INCREASING THE EFFICIENCY OF STEAM ENGINES.

The recent centennial anniversary of the Royal Technical High School at Charlottenburg was made the occasion of several important announcements concerning the work of that renowned institution, which embodies in a remarkable degree the advanced technical science which has done so much to push Germany forward into the front rank of manufacturing nations. Among these, the first rank is, by common consent, accorded to the paper ol Professor E. Josse, head of the mechanical laboratory, in which are described with elaborate detail the results of his experiments with an original and highly interesting process for increasing the efficiency of steam engines by utilizing the heat of the exhaust steam for evaporating another liquid having a lower boiling point than water.

It is well known that the steam boiler and engine, notwithstanding all improvements which it has undergone during the past 100 years, and its incalculable services to mankind, is nevertheless a wasteful and extravagant device for converting the energy stored in fuel into mechanical power. The ordinary simple, high-pressure engine, which, after passing steam through one cylinder, discharges it into the air, utilizes hardly more than five per cent. of the value of the fuel consumed under its boiler. The compound engine, in which the steam, after passing successively through two, three or more cylinders, is condensed, and the warm water ot condensation restored to the boiler, utilizes, under favorable conditions, 12 to 13 per cent. of the fuel energy, and there the economy appears to have stopped. An eminent American engineer has recently published an article reviewing the development of the steam engine, and closes his essay with the expressed opinion that with the compound machines and improved cut-off of recent years, the practical limit of efficiency of the steam engine has been reached. The invention described by Professor Josse introduces a novel element into the problem and opens a new chapter in the record of steam-engine development.

The process is the joint discovery of Mr. G. Behrend, a Hamburg engineer, and Dr. Zimmermann, of Ludwigshafen; and, although first patented in 1889, it has only recently been matured and its application perfected by the employment of an auxiliary engine, which, utilizing the heat contained in the exhaust steam, gains as high as 56 per cent. additional motive




Apparatus For Increasing the Efficiency of Steam Engines.

power without increasing the expenditure of fuel. The principle and process involved are simple, and may be briefly described as follows:

It is plain that, with all progress which has hitherto been made in steam-engine practice through higher pressures, superheated steam, economical cut-offs or successive cylinders, there is always an important an inevitable loss of heat energy when the steam, having done its work, is discharged into the open air, or changed back to water by contact with cold water in a condenser. When the exhaust is into the open air, the steam has a temperature of about 100° Celsius (212° Fahrenheit); when it passes into condenser, the steam has a temperature of 60° to 70° Celsius (140° to 160° Fahrenheit), according to the vacuum. The corresponding latent heat of steam, given up upon change of form from steam to hot water, has hitherto run to waste in the condensing or cooling water, or in the air. Messr. Behrend and Zimmermann attacked the problem of utilizing this wasted caloric by employing it to create a new supply of steam by evaporating some liquid which has a lower boiling point than water, and for this purpose they chose after many experiments, sulphurous acid ($H_2SO_3$), which is not only cheap and easily obtained,

but has the further advantage of a viscous consistency and lubricates the inner working surfaces of the machinery without corroding them. Their demonstrations, although not practically conclusive, were so promising that Professor Josse, as a technical authority on this subject, took up the problem, and after several months of highly satisfactory laboratory experiment, caused to be constructed and connected with an ordinary working steam engine of the compound type an additional condenser and auxiliary engine, the power of which could be exactly measured.

Referring to the diagram in which dimensions are given in millimeters, (H) and (N) represent the high and low pressure cylinders of an ordinary compound steam engine, with a stroke of 500 millimeters, (19.69 inches) and a speed of 41.5 revolutions per minute. From the low pressure cylinder (N) the exhaust steam passes into the surface condenser called in the diagram the "vaporizer." In this vaporizer or condenser, the cooling medium used, instead of water, is liquid sulphurous acid ($H_2SO_3$) which has a boiling point so low that it is immediately decomposed by the heat of the exhaust steam, whereby the sulphur dioxide gas ($SO_2$) is liberated, which passes over into the cylinder of the auxiliary engine (S), where its work is done, as in an ordinary steam engine. The auxiliary cylinder has a diameter of 300 millimeters (11.81 inches) and a stroke of 500 millimeters, with a speed of 77 revolutions per minute.

After passing through this cylinder, the sulphurous vapor enters the surface condenser, around the tubes of which cold water flows, as in an ordinary steam plant. Here the sulphurous vapor is condensed to liquid and is forced by pump (P) back into the vaporizer, where it begins its cycle again, the same ($SO_2$) being used over and over again indefinitely. There are, therefore, in fact, two condensers, the first serving, as it were, as boiler or steam generator for the auxiliary engine ; and this boiler instead of being fired by coal, obtains all its heat from the exhaust of an ordinary steam engine, and, instead of converting water into steam, evaporates a liquid which is much more volatile, i.e., has a far lower boiling point.

In the long series of recorded tests with the plant employed, the following results were attained :

The steam engine is of the compound type, of good, modern construction, and being given a steady load, developed 34 indicated horsepower, with a consumption of 8.6 kilogrammes (18.96 pounds) of steam per incated horsepower-hour. The auxiliary machine working with the sulphurous vapor indicated 19 horsepower, that is, an increase of 56 per cent. and yielding, instead of one horsepower, 1.56 horsepower for the same steam consumption, and reducing the steam consumption from 8.6 kilogrammes to 5.5 kilogrammes (from 18.96 to 12.13 pounds) per indicated horsepower.

The experiments showed on the average that for every 15 kilogrammes (33,169 pounds) of steam passing through the main engine, one h.p. could be gained in the auxiliary machine. Applied, therefore, to an ordinary single-cylinder steam engine, exhausting into the air at high temperature, the percentage of power saved by this new device would be very much higher than the eeonomy reached in these experiments, which as has been shown, were made with a highly improved compound engine. From the average of these experiments, it may be broadly stated that, given a fairly economical compound engine, using 7½ kilogrammes (16.5 pounds) of steam per indicated horsepower-hour, half an indicated horsepower could be produced in the auxiliary machine for every indicated horsepower developed in the main engine. Assuming an average vacuum of 60 centimeters (23.62 inches, corresponding to a temperature of 60° Celsius (140 Fahrenheit), the saving of heat must be accomplished by using a liquid which can be vaporized to a high pressure at or below that temperature. Assuming further, the upper and lower limits of temperature within which the operation is confined to be 60 and 20° Celsius (140° and 67 Fahrenheit), the pressure of the sulphurous vapor would range from 10.05 down to 2.35 atmospheres above open-air pressure. A working pressure as high as ordinary steam-boiler pressure is, therefore, readily obtained at a comparatively moderate temperature. Moreover, the volume of sulphurous-acid vapor necessary to contain the number of heat units corresponding to the work to be performed is much smaller than the volume of steam which would be required for the same purpose. As the saving to be effected by the auxiliary engine depends directly upon the difference between the highest and lowest temperatures involved, the greatest gain will, therefore, be made either when the water in the surface condenser is as cold as possible, or when the heat of the exhaust steam from the engine is at a maximum, as is the case with a single-cylinder steam engine without condenser, which may be anywhere up to 212 Fahrenheit.

The expense of this improvement is practically all in the construction cost of the vaporizer, condenser and auxiliary engine itself, and its economy may be realized from the fact that the exhaust steam from a 2,000 h.p. central station engine should furnish power to drive an additional 1,000 h.p. engine, which can be connected as an extra cylinder to the steam engine or run independently, and thus increase by 50 per cent. the power developed without adding a pound to the quantity of fuel consumed. When, in view of the present coal famine throughout Europe, it is remembered that the steam-engine energy of Germany alone, afloat and ashore, is not less than 3,717,264 h.p., the commercial importance of such an improvement will be readily apparent.

## ALUMINUM AS A CONDUCTOR.

The Chicago Record says that aluminum is to have its first important trial as a commercial conductor of electricity on the Northwestern Elevated Road. Twenty miles of inch and a half cables—150,000 pounds of the light-weight, silvery stuff—are to be strung along the steel trestle to distribute the motive power to the trolley rails of the new road. Aluminum displaces its copper rival on the new road because of its cheapness. Copper has almost doubled in price within a twelvemonth while the lighter metal has dropped a shade in the scale. James R. Chapman, the electrical engineer in charge of the new road, says : "After copper, aluminum is the best conductor among the cheaper metals. An aluminum wire has the additional advantages of being lighter to handle and of being non-corrosive." According to Mr. Chapman, a perfect joint has been made possible by a solder invented by a Chicago man.

Beginning with the January number, the publishers of Science Abstracts, of London, England, introduced a chapter on "Steam Plant, Gas and Oil Engines," also abstracts dealing with motor cars in general.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

OFFICE: CONFEDERATION LIFE BUILDING,

Corner Yonge and Richmond Streets,

TORONTO, - - CANADA.

Telephone 2362.

NEW YORK LIFE INSURANCE BUILDING, MONTREAL.

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### REMOVAL NOTICE.

**On May 1st next the Montreal office of The CANADIAN ELECTRICAL NEWS will be removed from the New York Life Building to the Imperial Building, corner St. James Street and Place d'Armes Hill.**

**Underground Cooduits.**

IN the larger cities of Canada the advantages of underground conduits for electric wires are gradually being recognized by the electrical companies. The Lachine Rapids Hydrulic & Land Company have placed their wires underground along many of the principal streets in Montreal, and it is observed by the report of the directors that the system has been found eminently satisfactory. The Montreal Street Railway Company are about to take similar action. Apart from enhancing the appearance of a city by the removal of unsightly poles, we believe that the underground system will be found to have many advantages for the electrical companies as compared with the present overhead construction, at least in the congested business sections in cities. While the first cost of installation will be heavy, this will in time be overbalanced by the comparative freedom from accidents, interruption from sleet storms, etc.

**The Use of Storage Batteries in Central Stations.**

THE history of the storage battery on the American continent has been a curious one, and illustrates the difference in methods and conditions existing between American and European practice. While on the continent the storage battery was recognized as an almost essential part of the station equipment, and in England its value was largely conceded; in America until 1894 the records show that the installations using a battery plant were few and far between and generally far from successful. The larger use of batteries in Europe is due to several causes, chief among them being the fact that by far the larger number of stations existing there are of the direct current order, while on this side the alternating stations preponderate. In addition to this it appears that until 1894 the storage field was being exploited in America by a number of weak companies, among whom considerable rivalry existed tending towards the practice of obtaining business by any method at hand, working for immediate returns only, and litigating in the patent courts. The results were that the storage battery was applied in many cases where its use was not justified, and the proper precautions were not taken to ensure that the equipment was large and substantial enough to stand the severe operative conditions imposed by heavy discharges. In Europe, on the other hand, proper engineering methods prevailed, in consequence of which we find successful installation from the first. Since that time, however, a consolidation of interests has taken place in America, and the trade is largely in the hands of one powerful company, with the result that since 1894 the sales of batteries have increased almost twelve fold. This tremendous increase is due to the fact that the larger stations in the American cities have recognized the usefulness of the storage system and applied it not only to the lighting demands, but latterly and very extensively to the needs of street railway systems.

The improvement which has taken place in the operation of the storage battery on this continent has been due not to any great advance in the direction of newer and more efficient types of cells, but to the gradual improvement of those already existing as regards their

mechanical features, their more intelligent handling while in operation, and more important than any, that with proper engineering the conditions of operation have determined the type and capacity of the cells and not the mere question of first cost. These points having been given proper attention, it became evident to the larger lighting companies that the battery had a place in their equipment, and the smaller companies, although slower to recognize its value, are now more rapidly falling into line, and in Canada a careful consideration of the question will no doubt lead to the adoption of batteries in at least some of the larger steam stations. While each case must be considered upon its merits, and no general conclusions can be arrived at which will suit all cases, there are a few land marks which will serve as guides in determining the question for any particular plant.

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Generally speaking, the uses to which a battery plant can be put in central station practice are as follows: First, to carry the peak of the load; second, to carry the entire minimum load for whatever time it may exist; third, to act as an equalizer or reservoir, charging and discharging as the fluctuations and variations of the load demands; fourth, to be used in sub-stations to assist the regulation over the feeders and to cut down the cost of feeder copper, which would be designed for the average load instead of the maximum. In the lighting station the first two uses are generally given first consideration, and for traction work the latter two; and in a combination station, of course, each use demands a careful investigation. The case of use for the peak of the load is usually first met with when it becomes necessary to install more apparatus to meet increased demands, and the relative merits of additional steam apparatus or battery equipment then come up for consideration. For this use in lighting stations, as the peak of the load is of short duration, the battery should be suitable for a high discharge rate for a short time, so that the cost per kilowatt available over the time under consideration should be given the first consideration and serve as a basis of comparison with the cost per kilowatt of steam plant. In the case where the battery is to be used to carry the minimum load over longer periods, say from midnight on, the kilowatt hours of capacity becomes the chief consideration, apart from its ability to be rapidly charged and discharged, and it will be found that the cost per kilowatt hour for batteries for the two cases above mentioned is vastly different. For instance, a battery for an eight hour discharge rate may cost from forty to forty-five dollars per k.w. hour, while if the discharge rate be one hour the cost will probably be nearly three times as much per k.w. hour. A point which is frequently misunderstood in dealing with rapid rate as distinguished from slow rate discharge of batteries is the efficiency. It may be stated that if an eight hour battery be discharged in one hour, its capacity in k.w. hours will probably be cut down fifty per cent., but this does not involve a corresponding decrease in efficiency, as, if the battery be recharged, the input will correspond with the amount taken out, less, of course, the inherent losses due to charging which exist in every storage cell. For this reason it becomes apparent that the cost of a rapid rate battery will be greater per k.w. hour than a slow rate battery of a similar capacity, while the efficiency should not be very different. It should also be noted that while the ampere efficiency may be 90 per cent., the watt efficiency as measured by the ratio of watt output to input will seldom be found in practice to be higher than 75 per cent., and this latter percentage should be considered, and not the former, in dealing with the relative merits of the battery and steam plant as regards its effects upon the coal consumption.

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The question of depreciation is at once brought up for discussion when storage is suggested, and the battle generally ranges about that point. This is hardly to be wondered at when it is considered that the purchaser has before him the very unfavourable records of past years; and he is justified in assuming that modern installations have not been in existence long enough to demonstrate that the depreciation factor has been reduced to a commercial point by proper engineering of the plant and mechanical construction of the cells, as is claimed. The chief causes of battery failure are buckling, short circuiting, sulphating, disintegrating, and dropping of active materials, and it is safe to say that at least fifty per cent. of the depreciation accounts have been due to improper charging and discharging and general lack of attention given the cells while in the customers' hands. This is not due to the fact that the battery requires any great amount of attention, but for the reason that the action being chemical, troubles do not manifest themselves as in mechanical apparatus, and the battery which is being rapidly worn out appears upon casual inspection to be in fair condition. A proper recognition of these facts has contributed to cut down the depreciation allowed very largely. This matter of depreciation has forced many companies manufacturing batteries to guarantee this charge; and in America several large plants for severe work have been guaranteed at the rate of seven to eight per cent., while in Germany, where the experience has been more extensive, the manufacturing companies will maintain the cells for 4 per cent. of the cost per year under fair operative conditions; and many of the owners will not avail themselves of the offer, as they claim that they can maintain their equipments for less than that percentage. From these considerations it appears that, in figuring upon the depreciation and repair account of storage equipment, properly designed for the existing conditions of operation and properly inspected and handled, this portion of the plant may safely be treated as being subject to the same percentage allowance for depreciation and repairs as the mechanical portion of the station equipment. For obvious reasons the battery does not appeal to the manager operating a water power station unless the question of the load becoming greater than can be handled with the water available, becomes pressing, when the case becomes similar to that of a steam station in which the demand exceeds the capacity. In these cases it becomes a question between the use of additional steam plant and the installation of batteries. The advantage on the side of the battery is that it enables the steam plant to operate at a point nearer full load during the time of charging, and either relieves it of the peak of the load or enables the steam equipment to be shut down during certain portions of the twenty-four hours. Generally speaking, it will be be found that the cost of a battery equipment for the peak of the load will not greatly exceed, if at all, the necessary increase of steam equipment, and if it be allowed that the interest, depreciation, aud repair percentage allowance for similar investments will be about the same, the advisability of installing either depends upon the relative cost of coal and supplies and labor for the additional output. As regards the labour account,

it will generally be found that the battery has the advantage, especially where it allows of the steam equipment being shut down for a sufficient number of hours to permit of a reduction of the shift. As regards the coal consumption, the losses in the battery must be placed against the losses in the rival steam equipment, making also due allowance for the saving in coal per kilowatt output of the original plant while charging the batteries, due to the fact that the engines are running under greater load and therefore at a more economical point. In figuring the loss in the batteries, it must be carefully kept in mind that this loss only exists while the battery is in use and should not be figured as an all loss loss against the equipment.

The above considerations, while applying more properly to the use of batteries in lighting stations, are also generally applicable to their use for railway operating, although for this class of work the ability of the battery to absorb fluctuations in the loads becomes the prominent feature. This application is being taken advantage of more and more by the larger street railway companies, and even in such cases as Pittsburg, where coal costs only about 45 cents per ton, storage is in use to prevent fluctuations and to minimize sudden strains on the machinery. Even although the battery under certain conditions may not appeal to the station management, the customer may find it of advantage, as is illustrated by the use of batteries by the Buffalo Traction Company, which receives its power from Niagara, stores it during light load hours, and uses it to cut down the peak of the load, thus dispensing with the use of much mechanical apparatus and effecting a saving in the cost of power taken. It may be pointed out that in the larger cities where the power demands are of the best the average yearly output of the stations are usually under 40 per cent. of the capabilities of the steam machinery which must be installed to take the peak of the load in the winter, so that the operating companies have at least 60 per cent. of their available output locked up unless batteries are used, and the extra cost of production of this extra output would only be the cost of the additional coal, and could be very cheaply sold, and it is this power which is rendered available by the battery.

## THE CANADIAN ELECTRICAL ASSOCIATION.

Arrangements are progressing favorably for the annual convention of the Canadian Electrical Association, to be held in the city of Ottawa on the 27th, 28th and 29th of June. The committee appointed to arrange for papers have met with encouraging success, having secured the promise of certain papers from several persons prominent in the electrical industry. The local committee will meet at an early date to make preparations for the event, and we understand that every effort is being put forth to interest members and outsiders everywhere with a view to having a large attendance and profitable meeting, and with favorable weather the convention should be a great success. In next issue some particulars of the programme may be given.

Mr. Thomas Hawkins, well known in street railway circles in Montreal and St. John, N.B., left recently for Georgetown, Demarara, where he will superintend the installation of an electric plant. Mr. F. Brothers will leave shortly for the same place, he having been given the superintendence of the construction of an electric railway in which a number of Montreal capitalists are interested.

## MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
New York Life Building,

MONTREAL, April 2nd, 1900.

The Alien Labor Law keeps electrical wiring contractors of this country from going into the neighboring republic to secure contracts, yet their contractors can come in here, or rather send a representative, to take off quantities, figure on Canadian jobs at Canadian archtiects' offices, and there is no one to say to them "nay"; surely this is not just.

Dame Malvina Heve, widow of the late Alphonse Girouard, hotel-keeper, of Ste. Cunegonde, who was killed by an electric shock while in the act of lighting an electric lamp in his premises, is suing the Royal Electric Company for $15,000 damages. Some interesting evidence may be expected.

Spring business in the electrical contracting line looks good in this city. There are quite a number of architects soliciting tenders for wiring, one of the most notable being the combined hotel and station for the Canadian Pacific Railway Company, to be built at Winnipeg. This building is in the hands of Mr. E. Maxwell, architect.

The bad roads after the heavy snowfalls lately have made an increased demand on the Montreal Street Railway Company, so that each Windsor car resembles a box of sardines, in that humanity is packed to the greatest extent. In expiation, however, it is just possible that the high cost of iron, copper and similar necessities may be causing the management to await a more favorable time for buying, so as to increase the copper, power units and construction work. "Speed the time."

The Montreal Daily Star (Graham & Co.) intend installing considerable wiring for both lights and motors in their new building. Tenders are now being called for by the architect, Mr. A. F. Dunlop. It is stated that a United States expert was called in to draw up the specifications, which are certainly elaborate, but quite capable of having been drawn up by local consulting electrical engineers—in fact bettered.

It is now evident that the Montreal Street Railway Company will put certain feeders underground. In fact, it is also rumored that the Royal Electric Company are figuring on similar action. As the Lachine Rapids Company and Bell Telephone Company have both already made a start in this direction, the date when our "picket fence" (as a United States gentleman described the rows of poles) will be removed, may soon be in sight. Of course, no one at all acquainted with the business imagines that each and every pole will be dispensed with. A few must remain.

The heavy snow fall in this city about March 1st simply knocked the Montreal street railway off its feet, after a gallant fight had been put up. They were not long in getting into running order again, however, and even the time of stoppage could have been materially reduced had the city been a little more prompt in carting the snow off the streets.

No troubles seem to have occurred with either the Royal or Lachine Rapids Companys' circuits during the winter blizzards.

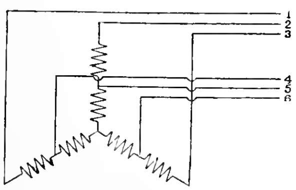
Quebec city seems to have caught it lively during the snow fall. It is reported that the street railway had some dozen or more cars, half a dozen sweepers, etc., stalled in the snow for about 24 hours.

The Jacques Cartier Water and Power Co. at Quebec are making some "fine cut" quotations in their fight for business against the existing Montmorency Company. One cent per lamp per night, less 10% for cash, is a sample of "some flat-rates."

The Power Publishing Company, World Building, New York, have favored us with a copy of a new work entitled, "Electric Wiring," by Cecil P. Poole. A perusal of this book proves it to be very interesting and valuable. It is designed to serve both as an instructor for practical wiremen who have occasion to lay out their own work, and as a convenience and general reference book for electrical engineers whose work includes the calculation of transmission circuits, etc. Reference tables and formulas are presented in convenient form. But perhaps the most valuable features of the work are the wiring tables for alternating current motors and the tables showing the corrected drop in inductive circuits. These are the only tables of the kind which have come to our notice. The price of the book is $1.00.

## A SIMPLE TWO-PHASE SYSTEM OF SECONDARY MAINS.

On the distributing network of the Hartford Electric Light Company, there is in use a simple means of distributing with a minimum number of wires the two-phase currents for both lights and motors. The secondary mains are three-wire for lighting and two-phase for power, largely underground and supplied in districts by manhole transformers. Each manhole has two transformers, one for each phase; each transformer being tapped out at its central point for the neutral of the three-wire 220-volt network. The secondaries of the two transformers are shown at A and B in the accompanying diagram of connections. One outside terminal of A is connected to one outside terminal of B, and in each direction four wires are carried. It will be noticed that to the right the upper three wires are those of the three-wire single-phase circuit from transformer A, and the lower wire coming from transformer B, with the wire next above it, gives a pressure of 220 volts of the other phase to motors in that direction. The neutral of




The Connections of Secondary Networks for the Distribution of Two-Phase Power and Three-Wire Lighting on Four Wires.

transformer A is not carried to the left, while that of transformer B is, and all lights in this direction are supplied from the three-wire system of the latter transformer, while in this direction also one wire serves commonly as one outer of the three-wire system and as one side of the secondary of the other phase. Thus four wires serve to give a three-wire lighting and a two-phase motor distribution and the lights are approximately equally divided between the two phases. The neutrals are, of course, not connected in to the motors, which run at 220 volts on each phase and are wired on the two-phase three-wire principle. It is obvious that there is between the upper and the lower wires going out in each direction an electromotive force consisting of the vectorial resultant of the two 220 volts which amounts to about 310 volts, but this increased pressure is no particular disadvantage on low-tension circuits. It is also obvious that the wire used commonly by both phases gets an increased current, but not sufficiently so to materially affect the regulation. The system has proven perfectly satisfactory.—American Electrician.

## INCREASED SCALE IN BOILERS IN DRY WEATHER.

Probably very few steam users have ever noticed that the formation of scale in boilers is much more rapid and troublesome in times of protracted drought than in times when the streams from which the feed water is taken are full; yet this is a fact well established by the reports of boiler inspectors, and should be taken into account by steam users whose feed water is from streams fed mostly by surface water from rainfall. The Locomotive, published by the Hartford Steam Boiler Inspection and Insurance Company, explains the increase of scale by dry weather. The reason for this, according to our contemporary, is not hard to find, the unusual deposits of scale being due to the increased hardness of the water after a lengthy spell of dry weather. In times of drought the water is drawn necessarily from the lower levels, in reaching which it has become impregnated with lime, magnesia, and other soluble substances contained in the overlying strata. In a season of copious rainfall, on the other hand, the ground, being soaked, cannot absorb the surface water, which rapidly drains off into rivers or reservoirs, as the case may be, before it has had time to dissolve out the scale-forming substances in any quantity. In a season of light rainfall the ground can absorb practically all the water that falls, and the proportion of surface water is relatively small. Hence in dry seasons the water used in the boilers will be largely spring or hard water, and in wet seasons it will consist chiefly of surface or soft water, the deposits of boiler scale being larger or smaller in proportion. The moral of all this is two-fold. In the first place, during a dry season boilers should be more frequently opened, examined, and cleaned. Just how much oftener this should be done must depend upon local conditions and the severity of the drought; but it is suggested that, judging from observations made in the State of Connecticut, they should be inspected in such a season as the last about twice as frequently. Another fact to be remembered is that when a heavy rainfall comes, bringing a sudden supply of surface—and, therefore, soft—water, the scale that is in the boiler will be suddenly loosened up, and unless precautions are taken it will lodge over the fire sheet and cause trouble. This is particularly liable to happen during the melting of the snow in the spring, when the water will be particularly free from mineral salts.

## THE CENTRAL ONTARIO POWER COMPANY.

At a recent meeting at the Queen's hotel, Toronto, of the shareholders of the Central Ontario Power Co., Limited (proprietors of the Burleigh Falls water power), lately incorporated with a capital of $750,000, for the purpose of developing the Burleigh Falls and other water powers, and for transmitting electric power to Peterborough and Lindsay and district, and for operating a radial s ystem of electric railways in the vicinity, the following directors were elected, viz.: Hon. Richard Harcourt, Toronto, president; F. A. Hall, Perth, vice-president; J. Alex. Culverwell, managing director; Hon. Senator, Peter McLaren, Perth; Eugene Coste, M. E., Toronto; James Kendrey, M. P., Peterborough; R. J. McLaughlin, Lindsay; F. W. Barrett, Edward T. Adams, M. D., Toronto; H. J. Taylor and H. E. Larkin, St. Catharines. The company have opened their head offices at Peterborough, the managing director, Mr. J. Alex. Culverwell, late of Toronto, having removed to Peterborough to take charge of the company's offices.

## PERSONAL.

Mr. W. B. Close, manager of the Toronto & Suburban Electric Railway, has tendered his resignation.

The death of Mr. George H. Betram, M. P. for Toronto, and head of the Bertram Engine Works Company, which occured on March 20th, was the cause of widespread regret. Mr. Bertram was a business man of marked ability. In 1892 the firm of Bertram & Company took over the manufacturing business of the Doty Engine Works Company, with later became the Bertram Engine Works Company, and largely identified with ship-building. Mr. Bertram was elected to the House of Commons in November, 1897.

Mr. W. J. Gilmour, manager of the Bell Telephone Exchange at Brockville, Ont., and superintendent of District No. 6, has been appointed Superintendent of Agencies in the Eastern Department of the Bell Telephore Company, with headquarters in Montreal. This division includes the territory east of Kingston in Ontario and the whole of the province of Quebec. Mr. Gilmour has been identified with the Bell Telephone Company for fifteen years, and his removal from Brockville will be regretted by the citizens.

Mr. P. McCullough, electrican of the Toronto Railway Company, will shortly leave for Liverpool, England, where he will assume the duties of chief electrician for the Liverpool Street Railway, which is operated by the corporation. At the present time there are but a few miles of electric railway in use, but it is proposed to install a complete system to replace the horse cars. It is a source of congratulation that Canadians are being chosen to fill such important positions.

## THE PROBLEM OF ARC LIGHTING FROM A 250 VOLT SUPPLY.*

By W. B. Sayer.

In the early days of electric lighting incandescent lamps were made for low voltages, and if it was necessary to use them with a high voltage, they were occasionally put in series. When the standard voltage came to be recognized as 100 no difficulty was found with incandescent lamps, but with arc lamps the difficulty of having to run two in series was met with to a comparatively slight extent. With, however, the present 250 volt supply this trouble was found to be greatly increased.

In order to meet this demand the enclosed arc lamp was brought strongly into notice, and besides having the advantage of requiring a greater voltage, it has the additional advantage of burning about twenty times as long as the open arc lamp. As regards the voltage that an enclosed arc lamp would burn satisfactorily at, the author had seen a lamp wound to take the full 250 volts across its terminals, but the result was simply an apology for light. As far, therefore, as a 250 volt circuit was concerned, there were only two arrangements in common use—viz., two enclosed arcs in series or four or five open arc lamps in series. The economy question was discussed from the consumers' point of view, and the obvious disadvantages of having five lamps in series, and so necessarily all controlled by one switch, was pointed out.

The author then went on to describe a series of tests he had carried out at the Glasgow Corporation lamp testing department by permission of Mr. Chamen. The results obtained are given in the following table, and it might be pointed out that they do not aim at theoretical accuracy, but rather at a good general practical comparison. The comparisons were made by the ordinary grease spot method, and also by the shadow method, and the ratio of the squares of the distances between the respective lamps and the position where the grease spot became invisible or the intensity of the thrown shadows equal were taken. As regards the globe used, the open arc lamp was fitted with an opaline globe, as generally now used, and the enclosed arc lamp was fitted with two obscured globes, as is customary in practical use.

TABLE SHOWING COMPARISON BETWEEN LIGHT-GIVING POWER OF OPEN AND ENCLOSED ARC LAMPS, AND COMPARISON WITH INCANDESCENT LAMPS ALL USING THE SAME POWER AND RUNNING ON 250 VOLTS.

| Type of lamp. | Open arc. | Enclosed Arc | | Incandescents (new clear globes) | | | |
|---|---|---|---|---|---|---|---|
| How arranged..... | 5 in series | 2 in series | Single | 16 of 16 c.p. | | 31 of 8 c.p. | |
| Steadying resistance | 4 ohms | 12 ohms | .. | .... | | .... | |
| Current............ | 10 amps. | 4 amps. | 2'75 amp | 4'4 amps | | 4'48 amps. | |
| Watts per lamp .... | 5co | 500 | 680 | 11(0 | 500 | 1120 | 500 |
| Comparison ..... | 1 | 0'375 | (.1 | 0'63 | 0'31 | 0'75 | 0.33 |
| Comparison (taking 16 c.p. as unity).... | 3'25 | 1'54 | 0'325 | .. | 1 | .. | 1'c7 |

The figures in the table speak for themselves. With regard to the steadying resistance in circuit with the single enclosed arc, this was combined with the lamp itself so that without unnecessary trouble this figure was unable to be filled in. Under the heading of power taken per lamp (in the case of the arcs, and of course per cluster in the case of the incandescents), owing to a mistake in the tests when testing the incandescent lamps, too much was taken, so a second column has been added reduced in proportion to bring the amount in line with the other figures. The comparisons were made with the open arc, but in order to make them clearer they have been reduced to a basis taking a 16 c.p. lamp as unity. It will be seen that a single enclosed arc lamp is only about one-third as efficient as a 16 c.p. lamp, that when two enclosed arcs are run in series the efficiency is about one and a half times that of a 16 c.p. lamp, while an open arc lamp has about three and a quarter times the efficiency of a 16 c.p. lamp. This shows the open type arc lamp to be over 100 per cent more efficient than the enclosed type arc lamp, the latter running under its most favorable conditions.

From these figures it is clear that the enclosed arc would have no chance of being popular with the public if a single open type arc could be used under similar conditions. The objections to open type arcs are: (1) The necessity of running five lamps in series, or if less are used, of absorbing the difference by means of a resistance; (2) Owing to five lamps being in series, any unsteadiness or flickering occuring in one lamp will be shown in the others on the same circuit, so that there will be five times the amount of flickering; (3) The necessity of having all the lamps in each series of the same size, type, and current. The enclosed arc lamps have the same objections, although to a very much less extent, but in the author's opinion any advantages in this respect are far more than counter-balanced by the less amount of light obtained from them for the same expenditure of power.

The author considers that there are two remedies that can be employed to overcome the difficulty of running open arc lamps on a 250 volt circuit—viz., (1) by the use of a step-down transformer; (2) by the use an arrangement designed by the author, and which he calls a "ganger switchboard." In this arrangement a separate pair of leads is run from every individual lamp to a central position where a main switch-board is fitted. This switchboard is so arranged that any lamp can be plugged into a circuit of five. The disadvantages of this method are two in number: (1) That special telephones or other signalling arrangements have to be employed for signalling to the main board, where an attendant has to be more or less constantly stationed; (2) all the lamps in the whole installation have to be exactly of the same pattern and size, and have to take the same current, and they must all be adjusted so as to work satisfactorily one with another in any combination. This difficulty is the more important seeing that as a rule arc lamps are now adjusted in the series on which they will be run, and are then numbered and set up in the same combinations. There was no doubt in the author's mind that when the number of lamps admitted of it the step-down transformer was the best and most satisfactory solution of the difficulty. He considered that the advantages might be enumerated as follows: (1) The economy that would result in being able to use any single lamp just when and where required; (2) the advantage of not being tied down to certain fixed sizes for the lamps, but being able to use just whatever size was required or was most suitable for the position; (3) that it was possible with equal economy to have any number of lamps installed, and not necessarily a multiple of five; (4) that extra lamps could be added when and where required; (5) that the voltage of the circuit could be made exactly that which was found to be the most satisfactory for the most efficient burning of the lamps.

There were, of course, objections also to the use of a step-down transformer for this purpose—viz., (1) the first cost, and also the maintenance cost; (2) the expenditure of power necessary to drive the transformer itself. In the author's opinion, however, these disadvantages are far more than counterbalanced by the advantages enumerated above. With regard to the latter objection, the author contended that his loss should be borne by the corporation o other supplying body, by fixing the meter in the secondary circuit of the transformer.

*Abstract of a paper read before the Institution of Electrical Engineers, Glasgow.

## MOONLIGHT SCHEDULE FOR APRIL.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | P.M. 7.00 | A.M. 4.40 | 9.40 |
| 2.... | " 9.00 | " 4.40 | 7.40 |
| 3.... | " 10.10 | " 4.40 | 6.30 |
| 4.... | " 11.10 | " 4.40 | 5.30 |
| 5.... | " 11.50 | " 4.40 | 4.50 |
| 7.... | A.M. 0.30 | " 4.30 | 4.00 |
| 8.... | " 1.00 | " 4.30 | 3.30 |
| 9.... | " 1.30 | " 4.30 | 3.00 |
| 10.... | " 2.00 | " 4.30 | 2.30 |
| 11.... | " 2.30 | " 4.30 | 2.00 |
| 12.... | No Light. | No Light. | ..... |
| 13.... | No Light. | No Light. | ..... |
| 14.... | No Light. | No Light. | ..... |
| 15.... | No Light. | No Light. | ..... |
| 16.... | P.M. 7.10 | P.M. 9.40 | 2.30 |
| 17 ... | " 7.10 | " 10.40 | 3.30 |
| 18.... | " 7.10 | " 11.30 | 4.20 |
| 19.... | " 7.15 | A.M. 0.30 | 5.15 |
| 20.... | " 7.15 | " 1.15 | 6.00 |
| 21.... | " 7.15 | " 2.00 | 6.45 |
| 22.... | " 7.20 | " 2.30 | 7.10 |
| 23.... | " 7.20 | " 4.10 | 7.50 |
| 24.... | " 7.20 | " 3.40 | 8.20 |
| 25.... | " 7.20 | " 4.00 | 8.40 |
| 26.... | " 7.20 | " 4.00 | 8.40 |
| 27.... | " 72.0 | " 4.00 | 8.40 |
| 28.... | " 7.20 | " 4.00 | 8.40 |
| 29.... | " 7.30 | " 4.00 | 8.30 |
| 30.... | " 7.30 | " 4.00 | 8.30 |

Total.........152.30

Mr. John M. Dixon has been appointed chief engineer of the new municipal buildings in Toronto, he having received the highest marks in the examination.

## HIGH-SPEED AUTOMATIC TELGRAPHY.

American experts have been afforded an opportunity to witness the operation of the Pollak-Virag high-speed automatic telegraph system between New York and Chicago, and study the practical application of the proposed innovation to commercial work. The invention is really a combination of telegraphy, telephony and photography—rather a complicated system, it would appear, to the average mind—yet the almost incredible speed of 150,000 words an hour can be attained, it is said, without difficulty. Of course, it would be impossible to read or record messages manually and much less send them at this rate of speed, and it is

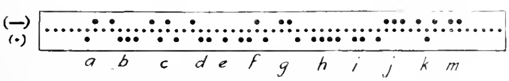



Fig. 1.—High-Speed Automatic Telegraphy.—Tape at Transmitting End Showing Dashes and Dots.

to overcome this difficulty that the telephonic and photographic features are introduced. The advantages claimed are high working speeds on the line wires with very low-voltage currents, a permanent and easily decipherable record, and automatic control of the receiver from the sending station. The fundamental idea is automatic transmission from a perforated strip of paper and receiving by photographing the movements of a telephone diaphragm.

Those who witnessed the experiments between New York and Chicago saw perforated strips similar to that shown in Fig. 1 fed into the "sender" and a series of irregular lines flashed upon a reflector, like the reproduction presented in Fig. 2, which is made from a photographic record taken on one of the trials. The apparatus employed is shown in the diagram Fig. 3. The illustrations are presented through the courtesy of the Western Electrician, from which the following description is taken :

In the preparation of the message the paper strip is perforated with two parallel lines of holes, one line representing the dashes and the other the dots of the Continental alphabet. In Fig. 3 (P) represents the paper strip; (A) and (A') are two brushes composed of fine wire mounted above a flanged drum or wheel (D) and arranged to press the paper strip firmly against it. The paper strip is moved forward in the direction of the arrow, and, as the line of holes representing the dashes pass under the brush (A), for each one there is made an electrical contract between (A) and the drum (D), and current passes from the positive pole of the battery (B) to the line. When a hole representing a dot passes under brush (A') the contact between it and the drum (D) permits the passage of negative current to the line. These impulses are carried to the telephone receiver (T), and the resultant movement of the diaphragm causes a ray of light to vibrate in the following manner : In front of the diaphragm is a small C-shaped permanent magnet (M), one pole of which terminates in a stiff flat spring having a right-angled knife edge at its free end, which is very close to a similar knife edge formed directly on the other pole of

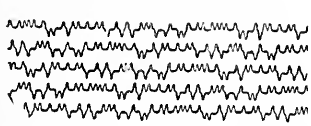


Fig. 2.—High-Speed Automatic Telegraphy.—How the Message Looks Coming Over the Wire.

the magnet. A very small concave mirror (W) is held magnetically against the two knife edges through the means of a small bit of soft iron glued to its back. A stiff piece of wire is connected rigidly between the telephone diaphragm and the flat spring of (M). It follows that the very slight motion of the diaphragm is transmitted to the spring and the mirror is caused to rock upon the fixed knife edge of the magnet. The light from a small incandescent lamp (L) passes through one limb of the forked tube (Y) and falls upon the mirror (W), from whence it is reflected through the other limb of the tube (Y). A light-proof case (K) is securely joined to the tube (Y). Inside the case (K) is a cylinder (F) carrying a sheet of light-sensitized paper. This cylinder is rranged to rotate around a stationary coarse-pitched screw, so that for each rotation the cylinder moves downward about one-quarter inch. The sending station is given control over the starting of the cylinder (F) by a simple automatic apparatus.

In receiving a message the cylinder (F) is rotated, the beam of light from the mirror (W) dances up and down, leaving its spiral, zig-zag chemical trail to be developed later and fixed as in photography and then translated.

An adjustable self-induction coil (S), Fig. 3, is connected at the transmitter as shown. Its function is to regulate the time duration of the impulses, proportionating them to the resistance and capacity of the line. A condenser (C) shunts the telephone receiver, as shown, for the purpose of damping the self-vibration of the diaphragm. Without this the diaphragm would not come at once to rest following each movement, but would make several short vibrations after each current impulse. The condenser prolongs or "tails off" the impulse so that the current just ceases as the diaphragm reaches the central or neutral position.

Telegraph officials in this country have encouraged the inventors, Anton Pollak and Joseph Virag, of Budapest, and they have placed every facility at their disposal for testing their apparatus on commercial lines, but none of them speak hopefully of the innovation, although they disclaim any feeling of antagonism. They point out that, taking everything into consideration the time required in preparing the perforted strips, in developing the photographic record, and in translating the message for delivery the advantage of high speed transmission is more than overcome by the rapidity of handling messages under the older and simpler system. The only feature of importance, they claim, that commends itself is the increase in the working capacity of existing lines made possible by the innovation, yet this would apply in only a few cases and hence would not be of universal benefit.

The United States consul at Roubaix reports that the expert of

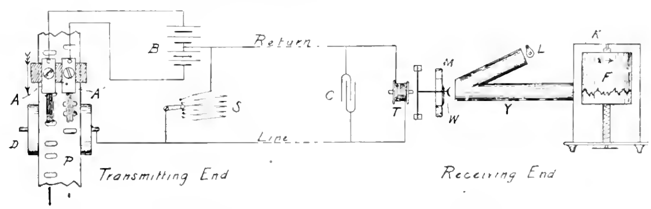



Fig. 3.—High Speed Automatic Telegraphy. Details of Apparatus.

the French government has made a careful test of the Pollak-Virag system, and in his conclusions, officially communicated, he points out the following disadvantages : "The telegram must first be changed into characters, after the manner of the Morse system ; then the strips must be perforated, as in the Wheatstone system ; after reception, the photographed strips must be developed and then translated into ordinary language." It is thought that this complicated manipulation may lead to many errors in transmission, and for present use in France he concludes that the Baudot machine actually employed answers all requirements.

## AS A TELEGRAPH OPERATOR.

The telegraph has always played an important part in war, and the official operator at the scene of action should combine skill with resource and good judgment. The proposed distribution of medals by the Dominion Government to the Canadian veterans of '66, recalls to mind that on the occasion of the Fenian invasion, about 10,000 troops were sent out from Montreal to protect the border line between the province of Quebec and the States of New York and Vermont. Attached to these troops was an official operator—a lad in his 'teens, supplied by the Montreal Telegraph Co.—A. B. Smith by name, now the well known and highly esteemed Superintendent of Construction for the G.N.W. Telegraph Co. Young Smith had his headquarters in a bed-room on the top story of the hotel at Hungerford, and during his stay at the "front" proved himself equal to all the demands of the occasion. When the Government medals are given out, as we hope they may be this year, the "official operator" of the Montreal contingent should be found on the list.

The Mayor of Toronto has outlined a proposal for the nationalization of the telephone and telegraph systems of the Dominion. An interesting discussion on this subject took place in the Dominion Parliament last month, during which the unsatisfactory telegraph service of Prince Edward Island was incidentally referred to.

# ENGINEERING and MECHANICS

## EXAMINATION QUESTIONS.

W. H. WAKEMAN, in The Tradesman.

The following seventy-five questions compose a list that was used one year by the examining committee of an engineering society for the purpose of testing the theoretical and practical knowledge of the men who applied for admission to its membership. No one candidate was asked to answer all of them, but selections were made according to the ability of the candidate and the time at the disposal of the committee.

Some of the points touched upon are in dispute among the best engineers in our land, and these are not supposed to be settled by us, but the answers given are sufficient to convince any reasonable committee or examining board that the candidate who gives them has some good ideas on the subjects, and few if any rejections will occur if these replies are given in an intelligent manner:

1. What is the first duty of an engineer on entering his engine and boiler rooms in the morning?

A. In a plant where he does the firing, his first duty is to ascertain where the water level is in the boilers, opening the valves on the water gauge, and trying all of the gauge cocks. If the pressure has all disappeared during the night, and a partial vacuum formed above the water line, the safety valve or some other valve should be opened to admit air. The practice adopted by some careless engineers, of starting up their fires before they know how much water they have, cannot be too strongly condemned. In all cases where the engineer has one or more firemen, he should know that they are in their proper places ready for duty, that there is plenty of water in the boilers, and that on general principles nothing will prevent starting up on time.

2. What is the last duty of an engineer at night?

A. To see that his boilers are filled to the upper gauge cock with water, then to shut off the water gauges, and know that the fires are properly banked so that no steam will be formed during the night.

3. How would you bank a soft coal fire at night?

A. Where the draft is very strong and the dampers are not tight, the surest way is to shove the fire back until nearly one-half of the grates are bare, then cover it over with fine coal that has been well wet down. In some cases it is customary to cover the fire just as it is used on the grate, but this is only done with safety where the draft can be effectually shut off.

4. Which cock or valve on the water gauge would you open first in the morning?

A. The top one, in order to blow steam through the glass and warm it up. If the lower one is opened first the water will be projected upward, and when it strikes the closed upper cock or valve it may break the gauge glass. It also throws water from the bottom of the boiler up into the top of the column, where it is not wanted.

5. Do you blow down your boilers every morning?

A. Yes. There is no better plan to be found than to open the blow-off valve a few seconds before the fire has started to make steam for the day. As the water has had a chance to settle during the night, some of the sediment will be blown out, and the blow-off pipe will never get clogged with sediment. Where this precaution has been neglected, blow-off pipes have been burnt off because there was no water in direct contact with the iron.

6. What compound do you recommend for the removal and prevention of scale?

A. I have no particular kind to recommend for all cases, but would select one that would meet the requirements of a given case.

7. When the water is low in your boiler, how do you proceed?

A. I never let the water get low in a boiler that I have charge of, unless it is caused by some accident that is beyond my control, such as the bursting of a pipe, or something similar. In such a case I would cover the fire with wet coal as quickly as possible, or with wet ashes if the coal was not at hand.

8. Would it not be better to haul the fire in order to be sure that no heat is left to burn the boiler?

A. No, because an attempt to haul a fire results in great increase of heat for a short time, when it is liable to do much damage.

9. If your boiler foams, how would you proceed?

A. Partially close the throttle valve, open the blow-off valve, and blow down, then close it and feed in more water rapidly. As soon as possible the cause of the trouble should be removed, as it may wreck the engine.

10. How would you reverse an engine?

A. If the valve gear is operated by an eccentric, and the valves have neither lap nor lead, the eccentric may be turned half way round the shaft and fastened there. The engine may be placed on one of its centers as a matter of convenience, but not of a necessity. These directions apply to a majority of engines now in use, but there are many special forms that require special directions, and there is at least one that cannot be reversed, so that if it is desired to reverse the motion of the driven machinery, the engine must be turned around on its foundation.

11. Suppose that the valve gear on your engine is driven by an eccentric held in place by set screws, and it should slip on the crank shaft, how would you proceed to set it in order to avoid delay in the mill or factory?

A. I should place the engine on one of its centers, partially open the throttle valve and move the eccentric in the direction that the engine runs until steam appears at the open drip cock, or indicator pipe at the end of cylinder where the piston is, and fasten it there. This will make it possible to run the engine until there is an opportunity to apply the indicator and properly adjust the valves.

12. Does keying up the crank pin and wrist pin boxes to take up lost motion lengthen or shorten the distance between the centers of the crank and wrist pins.

A. This will depend upon the design of the connecting rod, for with some kinds keying up shortens the distance, while with others it lengthens the same. The best design has one of each of these devices, so that the distance mentioned is kept practically constant. In common practice this is called lengthening or shortening the connecting rod.

13. What is a counterbore?

A. When the cylinder of an engine is bored out, a part at each end is made larger than the mainpart, and each one of these is called a counterbore.

14. A crank is 12 inches long. What is the stroke of the engine.

A. Twenty-four inches.

15. Which way does the water circulate in an ordinary tubular boiler?

A. Commencing at a point directly over the fire, it rises, then flows toward the rear end, falling to the lower part, then travels toward the fire box to replace what is constantly rising.

16 What causes draft in a chimney?

A. The difference in weight of the hot gases inside of it, and the colder air on the outside.

17. How many square feet of grate surface are under your boiler?

A. This, of course, will depend upon the design of boiler and grate. With an ordinary tubular boiler it is only necessary to multiply the length by the width to determine the square feet contained. For an upright boiler with a circular grate, the diameter must be squared (multiplied by itself), and the product multiplied by .7854. For a Hazelton boiler or any other kind where the grate is circular in form with a water leg in the center, the outer diameter is squared, also the diameter of water leg, and the latter subtracted from the former. Multiply the remainder by .7854 and the product will be the number of square feet in the grate.

18. How would you stop a man-hole gasket from leaking without shutting down the boiler.

A. There is no safe way to do this, for if a light pressure on the nut will not stop the leak it is best to cool off the boiler and ascertain the cause of the trouble.

19. How many kinds of safety valves are in general use at the present time?

A. Two. Pop valves and leaver valves.

20. What causes a safety valve to blow after the boiler pressure is reduced twenty pounds below the blowing off point?

A. Such action would denote that some part of the valve did not work freely. The lever should be lifted gently, and then forced down into place. This may stop it temporarily, but when-

ever a safety valve fails to work properly it should be repaired as soon as possible.

21. Suppose that your safety valve is set to blow at 80 pounds, but on returning to your boiler room after a short absence you find 100 pounds by the gauge, how would you proceed?

A. The excessive pressure shows that the valve is fastened to its seat from some cause, and if the lever is disturbed under such conditions it may suddenly release it, thus throwing a great stress upon the fulcrum and lever, which may cause a break that will allow the steam to be discharged with great force until the boiler is empty; therefore, it would be proper to cover the fire with fresh coal and check the draft, as soon as the unusual pressure is discovered, and use the steam as fast as possible in order to reduce the pressure, after which the lever may be carefully lifted and the valve opened.

22. How would you repair a dash pot that will not work?

A. That will depend on what the trouble is, for they are usually made very substantially, so that few repairs are necessary.

(Note—This question was introduced to test the candidate's knowledge of dash pots.)

23. What kind of oil would you use in the gag pot on a governor?

A. A light oil that will not quickly gum up the parts. Kerosene is frequently used for this purpose.

24. How thick would you carry a soft coal fire?

A. That would depend upon the amount of steam that the boiler must supply. If it is worked up to its full capacity the fire should be about twelve inches thick, but if the work is lighter a thinner fire will answer every purpose and probably give better results.

25. How would you proceed to abate a smoke nuisance?

A. In some cases the amount of black smoke emitted from a chimney may be greatly reduced by putting soft coal on the dead plate and allowing it to remain there for a short time, then shoving it on to the grate, for in this way the gases must pass over the fire and become ignited. Admitting air at the bridge wall is a good plan, and in some cases a jet of steam in the furnace makes a great difference. A large fire box makes it possible to get good results with little smoke.

26. What is a horse power?

A. 33,000 pounds raised one foot high in one minute.

27. How do you square a circle?

A. Multiply one quarter of the circumference by the diameter, or square the diameter and multiply by .7854.

28. How do you calculate the power of an engine?

A. Multiply the effective area of the piston expressed in square inches by the number of feet travelled perminute by the piston. Multiply the product by the mean effective pressure and divide by 33,000.

29. How do you determine the mean effective pressure acting on an piston of the engine?

A. By taking indicator diagrams and calculating it from them.

30. Is there more power developed on one side of the piston than on the other?

A. Yes, because on an ordinary simple engine, and also on a cross compound engine, the piston rod covers several square inches on one face of the piston.

31. At what part of the stroke does the piston travel at the highest rate?

A. Taking for example a horizontal engine and dividing the circle made by the crank pin to halves by a vertical line, the piston reaches its highest speed while the crank pin is travelling the half nearest the cylinder.

32. How would you determine the stress on a stay bolt?

A. Multiply the distance in inches between the vertical rows by the distance between the horizontal rows, and the product so obtained by the steam pressure. The final product is the stress on the stay bolt.

33. What is meant by the horse power of a boiler?

A. The evaporation of thirty pounds of feed water at a temperature of 100 degress Fah. into steam at seventy pounds gauge pressure. If the boiler is run under different conditions, the results must be reduced to an equivalent to the above.

34. How many square feet of heating surface constitutes one horse power in a boiler?

A. This will depend upon the grade of coal used and the available draft. For ordinary stationary practice with natural draft, fifteen square feet for a horizontal tubular boiler, or a water tube boiler, although some boiler makers have reduced this to twelve on account of competition.

35. How do you deremine the heating snrface of a steam boiler?

A. By determining the number of square feet in the shell heads and tubes, on which the fire is effective on one side, and that are covered with water on the other, and adding them together.

36. Does the boiling point of water in a steam boiler increase with the pressure on its surface?

A. Yes.

37. Why are hand holes and man holes made oblong instead of round?

A. In order to make it possible to remove the covers from the boiler when necessary, also to avoid cutting away the material as much as possible.

38. The area of a safety valve is twelve square inches, the distance from fulcrum to valve is 4 inches, and the distance from fulcrum to end of lever is 30 inches. With a steam pressure of 100 pounds, how much weight must be put upon the end of lever in order to balance the pressure, neglecting the weight of valve and lever?

A. 160 pounds. It is determined by multiplying together the area of valve, its distance from the fulcrum and the steam pressure, and dividing by the length of lever.

39. The pitch of rivets in a double riveted seam is three inches, and the diameter of rivets is three-fourths inch. What is the strength of net section of plate, compared with solid plate?

A. 75 per cent. of the strength of the solid plate. It is determined by subtracting the diameter of rivets from the pitch and dividing by the pitch.

40. Which will stand the greater pressure, a large boiler or a small one, all else being equal?

A. A small boiler, because there is a less number of square inches exposed to pressure.

41. Which is the more economical,a high or a low-speed engine?

A. So far as actual consumption of steam per horse power developed is concerned, the low speed is the more economical, but other conditions may make it advisable to use a high-speed machine.

42. Is it advisable to give an engine compression; and if so why?

A. Yes; because it results in a more quiet and easy running engine.

43. Why is lead given to an engine?

A. In order to secure a high pressure of steam at the beginning of the stroke and maintain it to the point of cut-off.

44. In what position does the eccentric of an engine stand in relation to the crank on one of its centers?

A. If the connection between the valve and the eccentric is direct, and the valve has neither lap nor lead, the eccentric will stand at right angles to the crank and in advance of it. If the connection is indirect, it may stand in the same relation, or it may be 90 degrees behind it. If the valves have lap and lead, the eccentric must be advanced accordingly.

45. What is meant by the "angular advance" of an eccentric?

A. It means the number of degrees that the eccentric is advanced beyond an angle of 90 degrees with the crank.

46. How would you proceed to line up an engine?

A. Take off the cylinder-head, remove the piston and rod, draw a line through the center of the cylinder, and ascertain if the guides are parallel to it; also see that the line passes through the center of the cross head at all parts of the stroke. If the wrist-pin cannot be removed, this must be done by measurement. The crank-shaft must be square with this line, the crank parallel to it, and the crank-pin at right angles to it.

47. Does a crank-pin wear flat or round?

A. As nearly all of the wear comes upon one side of the crank-pin the tendency is to wear flat, although there may be exceptions to the rule.

48. In what position would you put the crank of an engine when keying up the crank-pin boxes?

A. With a new engine it makes no difference about the position of the crank, but with an old engine having a flat crank-pin f the engine is put upon a center and keyed up closely, it will bind and heat when started up.

(To be continued.)

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Mr. E. Beck, of the Goderich Water Works Department, has been appointed engineer of the Bennett Furniture Company, of London, Ont.

A branch of the Canadian Association of Stationary Engineers has been organized at Vancouver, B. C., with the following officers: J. Saslet, president; W. Patten, vice-president; J. R. Bodger, secretary; Angus McAllister, treasurer; Chas. McFarlane, conductor; Joseph Cameron, bookkeeper; Messrs. Ryder, Dunham and MacFarlane, trustees.

## SERIES ALTERNATING-CURRENT ARC LAMPS.

The successful operation of arc lamps in series on alternating current seems to be entirely assured, and has given to the alternating system the final element to enable it to compete in all particulars with the direct current system.

The San-Gabriel Electric Company, of Los Angelos, Cal., are putting in the largest plant of series alternating arcs yet installed, and will use 850 Manhattan lamps and nine regulators. The operation of the lamp is mechanical rather than electrical, the loss in the mechanism being claimed to be but five watts. The mechanism is of the concentric single solenoid type and contains no springs. The lamp carries an electrical cut-out, thus affording protection to the mechanism. They can be placed upon circuits of any current from five to eight amperes without change of adjustment. The arc voltage is said to remain constant under all conditions. At 6.6 amperes, and 72 volts at the arc, the total apparent watts at the terminal is 475; total true watts 430. The true watts at the arc are 425, showing the loss to be five watts in the mechanism and the efficiency of the lamp to be .99. The power factor of the lamp is .91. In connection with these lamps the San Gabriel Company will use nine regulating reactance coils of 25 per cent. capacity; in other words, each coil will take care of the extinguishing of 25 per cent. of the circuit. The regulator consists of a single, automatic, regulating reactance coil in series with the lamps.

A single coil is swung at one end of a lever arm, so that by moving vertically it will enclose more or less of one leg of an upright "U" shaped core, the other leg acting to complete the magnetic circuit. At the opposite end of the lever arm is a weight which overbalances the weight of the coil, so that normally the coil is held outside of and above the core. When the circuit is completed to start the lamps, magnetic attraction causes the coil to be drawn down over the core. The action of the weight holds the coil in equilibrium when the desired current is flowing through the circuit. When lamps are switched off and the current tends to rise, the coil is drawn to further enclose the iron, the reactance effect increases, and the current is thus held constant. This regulation is claimed to be absolute to within one-tenth of an ampere, on any size regulator or at any load.

The loss in the regulator is, of course, constant, either at full or minimum load, being simply the $C^2R$ loss in the coil, plus a very slight iron loss. Regulation is said to be perfect to within onetenth of an ampere from maximum to minimum load.

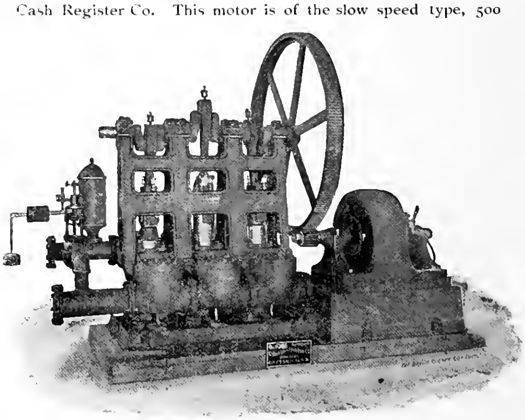
The capacity of the regulator, the insulation, etc., need only be in proportion to the number of lamps to be extinguished. This gives a very simple and compact device. It will be seen that where the regulator is to take care of but 10 per cent. of the load of the circuit, it requires an insulation against only ten per cent. of the total electro-motive force of the circuit, so that a large number of lamps, with a very high voltage, can be handled with safety. The loss in these coils is said be but 200 watts at any load, and as there will be but nine coils employed in this installation, the loss in the regulators will be 1,800 watts. The power factor of the circuit, including lamps and regulators, is 89 to 90. The lamps will run 100 in series on a 7,500 volt primary circuit. The Manhattan General Construction Company of Newark, New Jersey, furnished the apparatus for this installation.—Electrical Review.

## THE SMITH-VAILE TRIPLEX ELECTRIC PUMP.

One of the latest designs of the Smith-Vaile triplex electric pump of outside packed and outside guided type is illustrated herewith. The apparatus was constructed for and installed at the plant of the National Cash Register Co., Dayton, Ohio. It is connected to two 8 inch bored wells, and supplies an abundant water supply for general purposes.

The National Cash Register Co. have supplied a separate apartment for the installation of the pump about 10 feet below the floor line of the main engine room, so that the pump might be installed as near the water level in the wells as possible. Special underground passage gives communication between the engine room and the pumping station for the accommodation of the operating engineer.

The sub-base of the pump is extended for the reception of a General Electric direct connected motor, provided by the National Cash Register Co. This motor is of the slow speed type, 500 volt current, and its speed is such that a single reduction of gears can be employed. The main gear is of large diameter, machine cut. The pump and motor pinions are of rawhide. The pump is of the four standard type, each crank being provided with two bearings and two supports. It is also of the cross head design, cross-heads being provided with bronze shoes, adjustable for wear. Connecting rods are provided with bronze boxes at crank shaft connections, with taper key adjustment. Adjustment device is also provided at the cross-head connections. Valve areas and water passages are extra large, admitting of high speed without undue noise or hammer.



THE SMITH-VAILE TRIPLEX ELECTRIC PUMP.

The pump is also provided with automatic combination by-pass and water relief valve of a special design, whereby the pressure is maintained at a constant point, and when the maximum is obtained, the surplus water is by-passed from discharge to suction, speed of the motor remaining constant.

The Goderich Organ Company have lately put in a new 100 light dynamo, manufactured by the United Electric Company, of Toronto. It is operated by an automatic high speed engine from the Bell Engine Works, of Seaforth.

The London Cold Storage & Warehousing Co., London, Ont., have placed an order with the Electrical Construction Co., of that city, for a 30 k.w. direct connected generator and engine for 250 volt service to supply the lights of the building and two motors of 10 and 15 h.p. respectively, which have also been ordered from the Electrical Construction Co., of their Perfection type multipolar machines.

The Pittsburg Reduction Company, of Niagara Falls, Ont., are building a plant at Shawinigan Falls, Que., for the manufacture of aluminum, and have awarded to the Westinghouse Electric & Mfg. Co., of Pittsburg, Pa., a contract for four generators of 1,250 horse power each. The Shawinigan Water & Power Company are also said to have contracted with the Westinghouse Company for two generators of 5,000 horse power each, to be used in the development of electric power for their customers.

## SPARKS.

The town of North Toronto may install an incandescent lighting plant.

A fire alarm system may be installed by the corporation of Hintonburg, Ont.

The Kingsville Electric Light Company have installed a Leonard self oiling engine.

Cope & Frey, dealers in electric and gas supplies, have commenced business at Vancouver, B. C.

The power house of the Niagara Falls Park & River Railway at Niagara Falls, Ont., is being rebuilt.

The Cataract Power Company, of Hamilton, have made another reduction in their rates for lighting.

The Electric Development Company, of Philadelphia, purpose opening Canadian offices in the city of Hamilton.

The corporation of Cannington, Ont., is considering the purchase of the electric light plant from the present owners.

The electric lighting plant at Amherstburg, Ont., has been taken over by Mr. R. M. Saxby, late of the Royal Electric Company.

A proposition has been made by Tuerk Bros. to establish a factary in Berlin, Ont., to manufacture gasoline engines and automobiles.

A convention of electrical contractors of the United States was held in Pittsburg on March 16th.

The town council of Perth, Ont., have been looking into the question of electric lighting, and a report has been submitted recommending municipal control.

The streets of Port Dalhousie, Ont., are now lighted by electricity from the power house of the Toronto Rubber Shoe Company. There are fourteen arc lights in the streets.

G. Filieux, a lineman in the employ of the Royal Electric Company, Montreal, was recently killed by an electric shock at the corner of St. Lawrence street and Mount Royal avenue.

A considerable portion of the British Columbia Electric Railway Company's lines in Victoria will be double-tracked this year. It is also the intention to put in service several new cars.

Dr. Edward Gahan, of Boston, is understood to be in negotiation for the purchase of the electric light plant at Digby, N.S. If purchased, an additional dynamo and engine will be installed.

The tender of the Royal Electric Company has been accepted by the city of Halifax, N. S., for the supply and installation of an electric light plant. The tender is understood to have been $19,-438.

The Bay of Quinte Railway Company, of Deseronto, is seeking authority from the Dominion Government to operate mines, supply electrical power and manufacture electrical machinery. It is improbable that their requests will be granted.

McColl Bros. have been given the contract for boiler compound required by the city of Toronto, at 4 cents per pound, and for cylinder oil at 35 cents per gallon. The Atlantic Refining Company secured the contract for lubricating grease, at 10 cents per pound.

A Paris newspaper gives the following as the number of automobiles in use: Automobiles registered in Paris, 3,701; in the suburbs of Paris, 1,219; in the rest of France, 2,445; in the whole of Germany, 1,427; in the whole of England, 530; in the United States, less than 300.

The Railway Committee of the Ontario Legislature has reported the bill reviving the charter of the Ingersoll Radial Electric Railway, granted in 1897. The line will connect Ingersoll with Tilsonburg. The town council of Ingersoll have also decided to grant a franchise to the company.

The Engineering Society of the School of Practical Science, Toronto, have elected officers for 1900 as follows: President, F. W. Thorold; Vice-Pres., W. G. Chace; Graduate Reporter, C. H. Fullerton; 4th Year Reporter, R. Roaf; 3rd Year Reporter, J. T. Broughton; Treas., R. W. Morley; Cor. Sec., W. Brereton; Rec. Sec. A. Lang.

A charter has been granted to the Electrical Maintenance and Construction Company, Limited, of Toronto, with an authorized capital of $250,000. The provisional directors are: P. H. Patriarche, H. L. Dunn and P. D. Ball. The charter gives the company power to manufacture and operate electrical machinery, and to carry on the business of an electrical, mechanical, hydraulic and civil engineer.

Sir William Van Horne and James Hutchison, of Montreal, B. F. Pearson and Charles H. Cahan, of Halifax, and other Canadian capitalists, have obtained an exclusive franchise to operate electric railways and furnish light and power in the city of Port of Spain and the suburbs to a distance of five miles. The capital of the company will be $1,000,000.

The Hamilton, Grimbsy and Beamsville Electric Railway Company sued the Bell Telephone Company in the Division Court, Hamilton, for $60 damages for injuries to its poles and wires caused by the defendant's removal of its broken wires and poles after the snow-storm of December, 1898. Judge Monck has ruled that the defendant is not liable under the circumstances.

The new power house and plant of the Ottawa Electric Railway Company was completed last month. The work was supervised by Mr. W. H. Baldwin, hydraulic engineer of the company, and upon the inauguration of the plant he was presented with a beautiful gold watch by the president and directors in recognition of his efficient and faithful services. In a later issue we hope to publish a complete description of this power house.

The Society of Applied Science of McGill University, Montreal, have elected the following officers for the coming year: President, H. A. Burson; first vice-president, B. S. McKenzie; second vice-president, S. B. Clement; third vice-president, R. C. Wilson; treasurer, A. E. Beck; second year representative, E. Mackay; chief of the editorial board, A. R. Archer; members of the editorial board, H. E. Scott, G. Pike and J. A. Heamen.

The Cataract Power Company have commenced work on the construction of their second transmission line from the power house near St. Catharines to the city of Hamilton. It is expected that the line will be completed by the first of July next. The new line will have twice the capacity of the present wires, and will necessitate the increasing of the plant at the Victoria avenue transforming station in Hamilton. The investment for copper wire alone will be about $50,000.

Mr. W. T. Steward, electrical engineer, has submitted a report to the town council of Toronto Junction on the required changes in the lighting system of the town. Mr. Steward estimates the cost of putting in a lighting plant at the present power station at $16,000, and to place it at the water-works station at $12,000 additional. He recommends two 50 arc light dynamos at a cost of $1,000 each, one 100 k. w. alternator with instruments and switchboard, at a cost of $2,500, one 150 h. p. high speed compound engine at $1,650, and two 150 h. p. boilers at $1,200 each. The cost of transformers for 1,200 lights is placed at $1,800. Upon the basis of his estimate, the cost of lighting the streets with 100 arc lamps would be $3,419 per annum.

An interesting legal suit is now being heard in the Assize Court at Toronto. It will be remembered that in September, 1899, the warehouse of W. G. Harris, scrap merchant, was destroyed by fire, and that suit was brought against the Toronto Electric Light Company to recover damages, on the ground that the fire was caused by an electric wire. The action has already been tried and a verdict for the full amount given in favor of the plaintiffs, but the defendants claim that Judge Ferguson, who tried the case, failed to point out to the jury in his charge the exact hour of the fire. Harris claims that the company wrongfully placed wires on his building, and failed to properly insulate them, while the company claim that they were properly insulated, and that the fire was caused by spontaneous combustion.

In one branch of engineering, the development of steam turbines, much greater progress has been made in Great Britain and on the Continent than in the United States. In the electric lighting plant in Cambridge, England, several prime movers of this type are in successful operation. A Parsons steam turbine, directly coupled to a 500-kilowatt alternator, has been added lately. It runs at a high speed, 2,700 revolutions a minute. The regulation of the turbine is secured by an electric device, so that it can work in parallel with the other machines of the station when desired. A surface condenser leads from the turbine by piping and is installed in a space below the floor level. Beside it are the pumps for the water circulation, which are worked by gearing and endless screw from the main shaft. The alternator is of the four-pole type, with fixed field, and gives a voltage of 2,000 at 90 cycles. For the excitation 3 5 kilowatts is required at full load. The exciter, at 5 kilowatts, is connected directly to the shaft of the alternator.

## HOW TO USE EMERY WHEELS.

An emery wheel manufacturing company gives this advice to users of such wheels: Too great a variety of work should not be expected from one grade of wheel. If the amount of grinding will warrant it, several grades can be profitably employed, each carefully selected for its particular purpose. Wheels should be kept perfectly true and in balance. In order that they may not become in the least out of true an emery wheel dresser should be used to dress up the wheels a little each day, or as often as they require it.

In mounting emery wheels never crowd them upon the arbor. Use flanges at least one-third the diameter of the wheel. Flanges should always be concaved and fitted with rubber washers between flange and wheel. Have wheels slip easily on the arbor and screw flanges only tight enough to prevent wheels from slipping. Stands on which wheels are mounted should be heavy and strong, and solidly bolted to a firm foundation. Keep machine well oiled so that arbor will not become heated, otherwise there is danger of wheels breaking from expansion of arbor.

Users of wheels are particularly cautioned not to run wheels on shaky machines or on machines in which the arbors have become loose in the boxes from wear. See that rests are properly adjusted in relation to the wheel, otherwise accidents may occur owing to work being drawn between the wheel and the rest. Never run wheels at a higher speed than the maker recommends. Don't try to grind malleable iron witha wheel that was made for brass, as no one wheel can be made which will be just right for all kinds of metals.

To obtain the best results, emery and corrundum wheels should be run at a surface speed of 5,500 feet per minute. Wheels if run too fast will heat the work and glaze, and if run too slowly will wear away rapidly and do but little work. The same speed should be maintained as the wheel wears down, and the speed of the spindle should be increased correspondingly as the diameter of the wheel is decreased. Where there is a sufficient amount of grinding to warrant the use of more than one machine, this can be accomplished by transferring from the first or larger grinder to smaller ones as the wheels wear down, otherwise by means of cone pulleys.

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The snow storm early in March last caused a heavy loss to the Nova Scotia Telephone Company. Many of their wires in Halifax and vicinity were blown down. The cost of repairs was in the vicinity of $25,000.

Mr. W. T. Steward, an electrical engineer of wide experience has recently established an office in the Temple Building, Toronto, and is prepared to give expert advice on electrical projects, installations, and improvements to plants. It is Mr. Steward's avowed intention to take an entirely independent attitude as regards electric manufacturing concerns, and by so doing to give his patrons the benefit of unbiased advice such as is only possible under these conditions. He has just made a report on an electric lighting system for the town of Toronto Junction. Mr. Steward is well known in electric circles in Western Canada, having been for ten years electrician for the western division of the Canadian Pacific Railway, and afterwards engaged in the electrical contracting and supply business at Vancouver, B. C.

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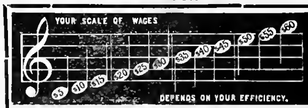
The Western Ontario Hat Co., London, have purchased two new motors in addition to the two they already have, all being manufactured by the Electrical Construction Co., of London, Ltd.

The Erie Iron Works, of St. Thomas, Ont., have placed an order with the Electrical Construction Co., of London, Ltd., for a 12 h.p. motor, which has already been installed to their satisfaction.

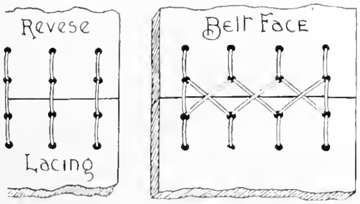




## SUGGESTION FOR BELT LACING.

Editor Canadian Electrical News:

Dear Sir,—Many suggestions are offered from time to time regarding the lacing of belts. Recently, I came across the double lath tie, which I have found very satisfactory, laced as follows: The lacing




can be made any length in a few minutes, and with one cut of a sharp knife it is easily removed. For heavy belts I use double and sometimes treble tie. By placing the ends together, sharpening them with a knife, and sewing them with one strand of the lath tie, makes the end very stiff. I can vouch for its cheapness and lasting power.

Yours truly,

"Excelsior."

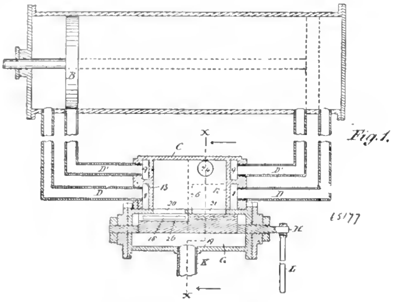


Mr. Stewart Randall, of Ottawa, has been engaged as electrician by the Buckingham Electric Light Company.

Mr. Daniel Mulqueen, cashier of the Toronto Railway, has been appointed by the Mackenzie Syndicate as manager of the street railway at San Paulo, Brazil.

## RECENT CANADIAN PATENTS.

THE William Hamilton Manufacturing Company, of Peterboro Ont., has been granted a Canadian patent for a reversing steam valve, as shown in the accompanying illustration. The claim is for a steam valve, comprising a tubular valve cylinder having a feed inlet and feed exhaust ports, a valve rocking therein and




REVERSIBLE STEAM VALVE.

having feed and exhaust passages from opposite ends alternating as described and adapted to close the feed port near one end and open the exhaust port at the other end, and vice versa, a steam chest connecting with said ports and having steam passages agreeing with said feed and exhaust ports, and feed and exhaust pipes from opposite ends of said steam chest and connecting with said steam passages and with a piston cylinder near opposite ends.

To Dr. Carl Ritter Auer Von Welsbach, of Vienna, Austria, has been granted a patent in Canada for an osmium filament for incandescent electric lamps. It consists of a process of making filaments for electric incandescent lamps from a paste of osmium, titantic acid or acid of a more basic character which will volatilize, when brought to incandescence, and binding material consisting in moulding the paste into threads or the desired filamentary form, subjecting the same to dry distillation, then applying the electric current, first slowly and until the carbon of the binding material has been eliminated at a comparatively low heat, then increasing the current until the filament is heated to dazzling incandescence, when the titanite acid or oxyd used is volatilized and the impurities, when any, eliminated and the osmium cemented into a state of purity as a stable, dense, homogenous, coherent and elastic filament ; in the substitution of alloys of osmium with other metals of the platinum group, and preferably ruthenium, in lieu of osmium alone, so as to produce metallic filaments suitable for use as the illuminating conductors of incandescent electric lamps, either alone or after being coated with refractory oxyd or oxyds.

## A WESTERN ELECTRICAL PROJECT.

INCORPORATION has been granted by the provincial legislature of British Columbia to the Stave Lake Power Company, Limited, with an authorized capital of $1,000,000. The company have acquired the right and title to 75,000 inches of water at Stave River Falls, a point 42 miles from the city of Vancouver. It is proposed to generate the power at the falls and transmit it to Vancouver. It is said that the company are already assured of over 4,000 horse power on yearly contracts.

The directors of the company are : H. Abbott, director of the Canadian Pacific Railway Company ; John Hendry, president and manager of the Hastings saw mills ; W. H. Armstrong, of Armstrong & Morrison, manufacturing machinists ; G.C. Hinton, electrical engineer and representative of the Royal Electric Company, Montreal ; J. B. Ferguson, managing director of the company.

The hydraulic engineer for the company is Mr. Chas. A. Stoess, and the electrical engineer Mr. George C. Hinton. Reports made by the engineers state that 17,000 horse power can be generated at the falls, and that by additional hydraulic works this amount can be doubled. The cost of the project is estimated to be $515,000. Among other information given by the hydraulic engineer is the following : Width of river, 200 feet ; average depth, 16 feet, running at a velocity of 7/10 of a foot per second, which gives a quantity of 140,324 cubic feet per minute. A flume will be constructed 18 feet high on a grade of one in 660, or 8 feet to the mile. This flume will pass from above the first fall to below the second fall. A dam will be constructed at the upper point and will likely be built of rock and earth backing and apron, with concrete cement cores. At the lower point of the flume the power station is to be located, and a reservoir will take the water from the flume. From this two steel pipes, 12 feet in diameter, will carry the water to the station, where there will be eight turbines developing 2,000 h.p. each. There will be four gates on each pipe, and each gate will serve a double turbine.

## SPARKS.

The project for an electric railway between London and Port Stanley has again been revived.

The city of Winnipeg, Man., is inviting tenders up to Monday, April 16th, for the supply of a fire alarm system.

The Electrical Construction Co., of London, Ltd., have cleared out twenty-two of their list of eighty second hand machines which were recently exchanged for new ones in Winnipeg.

The Hamilton Radial Railway Company, which contemplates the operation of an electric railway from Hamilton to Oakville and Guelph, has been granted an extension of time for beginning the work until 1905.

The Ickes & Armstrong Syndicate expect to commence work on the construction of an electric railway in the town of Woodstock, Ont., within two months. Mr. J. G. Wallace, the local representative, states that the ties for the road have already been purchased.

Messrs. S. H. Jones, S. F. McKinnon, L. M. Jones and J. A. Lowell have petitioned the Ontario Legislature for an act to authorize the construction of a system of elevated railways in the city of Toronto and adjoining municipalities, and also a system of surface street railways.

The Sutherland Construction Company, composed of New York capitalists, have secured control of the horse car line between Drummondville and Niagara Falls, Ont., and propose to electrify the road. They have deposited a check of $1,250 as a guarantee that they will install a plant before July 1st next, and have asked for a twenty-year charter.

The shareholders of the Preston & Berlin Street Railway Company have elected the following officers: John Patterson, President, Hamilton; M. M. Todd, Vice-President, Galt; C. R. Hanning, Secretary-Treasurer. The company will make arrangements at once to build a line between Preston and Berlin, thus making a through connection from Galt to Preston and on to Berlin and Waterloo.

SPARKS.

The Raney Specialty Mfg. Co., of Kingston, have purchased rom the Electrical Construction Co., London, three motors for their new works.

The town of Bracebridge, Ont., is considering the installation of an electric power plant, and may also put in an electric fire alarm system.

The Canadian General Electric Company have invited tenders for the erection of a brick and steel addition to then works at Peterboro, Ont.

The streets of Kingsville, Ont., are now lighted by incandescent lamps, instead of arc lamps as previously. The service is said to have been much improved by the change.

The Electrical Construction Co., of London, Ltd., have sold to H. W. Petrie, of Toronto, two of their list of second hand motors, which are said to have given excellent satisfaction.

Mr. Peter Hoff, ot Thornhill, near Toronto, has invented a fender for street cars, which operates by the pressing of a foot lever by the motorman.

The W. J. Gage Co., Toronto, have puchased two new motors from the Electrical Construction Co., of London, Ltd., in addition to the two slow speed press motors which they already have from this company.

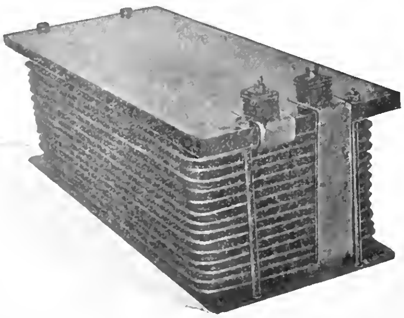
The Record Printing Co., of Windsor, have purchased from the Electrical Construction Co., of London, Ltd., a 40 light multipolar dynamo. This machine was sold in close competition with several American and other machines.

The Brampton Gas Company, of Brampton, Ont., are understood to be considering the installation of an electric light plant. The plant by which the streets of the town were lighted was destroyed by fire about one month ago.

The Georgian Bay Navigation Co. have recently ordered a 300 light dynamo from the Electrical Construction Co., of London Ltd., for one of their boats. This is to take the place of a 150 light dynamo installed two years ago by the same company.

An explosion at the gas works at Listowel, Ont., slightly damaged the electric light plant, and almost completely wrecked the gas works. Mr. William Bitton, the operator at the gas works, was killed by the explosion. Since the accident, the electric light plant has been put in running order, and arrangements have been made by J. G. Hay to rebuild the gas works.





CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

Vol. X. MAY, 1900 No. 5.

## MOUNT WHITNEY ELECTRIC POWER TRANSMISSION.

As being one of the latest and most interesting installations in the United States, we present some illustrations and particulars of the electric power transmission plant of the Mount Whitney Power Company. This plant was installed for the purpose of utilizing the waters of the Kaweah river, in California, for furnishing light and power to the cities of Visalia and Tulare and throughout Tulare county.

The Kaweah river rises in the Sierra Nevada mountains, one of which, Mount Whitney, is over 14,000 feet above the level of the sea. The river is fed by the waters from these mountains and winds its way through the valleys, then down the canyon, over precipices and through gorges, to Tulare Lake, bearing the waters from a drainage area of 619 square miles. At a point distant about 45 miles easterly from the city of Visalia, named Oak Flat, at an elevation of about 2,400 feet above the sea level, a solid granite ledge crosses the river and forms a perpendicular bluff on the south side, as well as a natural dam of about 12 feet in height above a pool below into which the waters of the river flow, thus forming a splendid waterfall. A tunnel three feet wide and six feet high conveys the water to a flume which is 30,000 feet in length. The inside dimensions of the flume are 36 inches wide and 22½ inches deep. It has a uniform grade of 26.4 feet per mile, giving a maximum velocity of flow of seven feet per second. At intervals sand boxes and waste gates have been provided, so that any sand which might find its way into the flume during the period when the snow is melting can be easily disposed of before reaching the pipe. The maximum carrying capacity of the flume is 37 cubic feet per second. The flume terminates in a sand-box and overflow gate, at right angles to which an apron leads off to the penstock. This apron is equipped with gates which regulate the amount of water which may flow into the pipe, and also with iron racks which prevent the entrance of anything which might be floating in the water. The penstock is 6x8 feet and 16 feet deep.

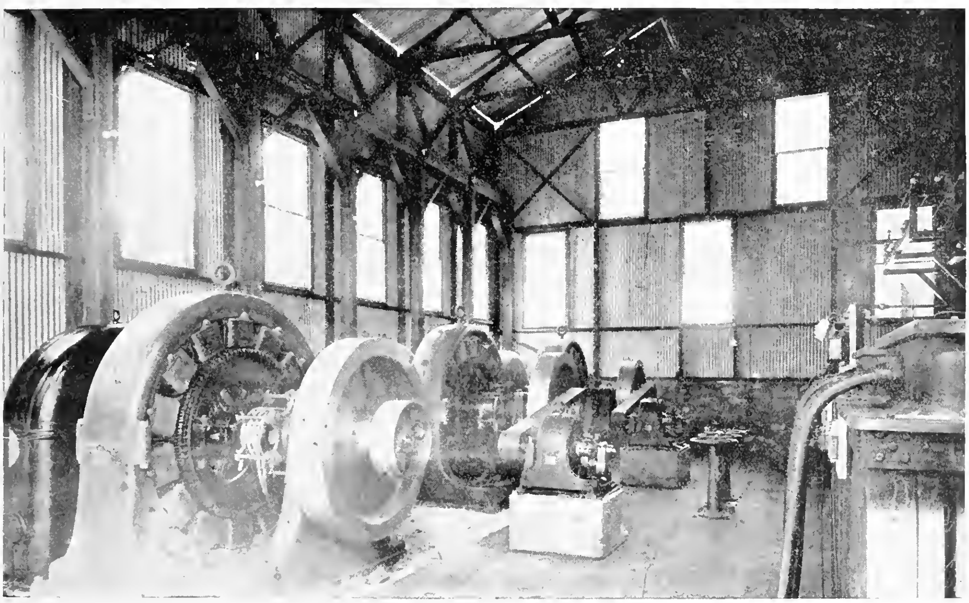


Fig. 1.—Generator Side of the Mount Whitney Power House.

### THE PIPE LINE.

The pipe line extends in a straight line from the penstock to the power house. It is 3,500 feet in length, and has a perpendicular fall of 1,300 feet. It follows along on ridges the most of the way and passes down over some very steep pitches. Commencing at the penstock the pipe is 50 inches in diameter, but it tapers down to 24 inches in the first 50 feet. This acts as a funnel and gives the water an easy entrance to the pipes.

Then follows 2,100 feet of rivetted and 1,160 feet of welded pipe, from 24 to 20 inches in diameter. A portion of the pipe is at an angle of about 45 degrees, and much of it at angles from 25 to 30 degrees. The capacity, with 20 cubic feet of water per second, is 2,800 horse power to water wheels.

THE WATER WHEELS.

The power house is located about 35 miles from Visalia and is 30 × 50 feet, with an addition 12 feet square. The

FIG. 2.—DOBLE ELLIPSOIDAL WATER WHEEL.

side of the building stands parallel with the pipe line and the water is led to the water wheels through passages of gradually decreasing area and with very easy curves. The water wheels are of the Doble ellipsoidal type and are solid steel castings, weighing about 1,400 pounds each, with 20 bronze buckets attached securely by means of two steel bolts to each bucket. A view of the Doble water wheel is shown in Fig. 2, while Fig. 3 shows a verticle section, with baffle-plates and tail-race. The steel centres are 44 inches in diameter, and the speed of the wheels is 514 revolutions per minute, giving a maximum capacity of 1,000 horse power each. The wheels are mounted directly upon the generator shafts, and the regulation is entirely by hand, aided by three annealed cast steel fly-wheels mounted on the opposite end of the generator shaft. These fly-wheels are 50 inches in diameter, 10½ inches face, and weigh 4,000 pounds. The water which is deflected downward by the cut-off device into the tail-race is received upon heavy cast iron baffle-plates and thence conveyed harmlessly away to the river. The wheels were manufactured by the Abner Doble Company, of San Francisco.

ELECTRICAL EQUIPMENT OF POWER HOUSE.

The electrical equipment consists of three Westinghouse three-phase alternating current generators, separately excited, slotted type, continuous winding armature, 450 k.w. each, 1,020 amperes, 440 volts, 7,200 alternations, with speed of 515 revolutions per minute. The illustration on first page is a view of the generators. The weight of each generator unit is over 40,000 pounds. Fourteen field poles are used, being separately excited by small direct current machines. The three generators give a normal capacity of 1,800 horse power. There are two belt-driven direct current generators of 15 k.w. each for exciters, which supply a current of 125 volts at a speed of 1,050 revolutions per minute. Each exciter has sufficient capacity to excite the two generators and is so located in the power house that it can be driven from either generator. There are four step-up Westinghouse transformers of 500 k.w. capacity each, of the oil-insulated, air-cooled type. These are three phase transformers of a primary voltage of 440, while the secondaries may be divided to deliver current at either 17,300 or 34,600 volts.

The switch-board consists of five marble panels all two inches thick and 65 inches high, four of them being 24 inches and one 36 inches wide, mounted on an iron frame. There is one exciter panel containing ammeters, two 3-pole single brake switches, two voltmeters, plug receptacles and pilot lamps. There are three generator panels, each containing one voltmeter, one ammeter, one voltmeter plug receptacle, one 3-pole quick-brake main switch, two field plug switches, one rheostat, synchronizer plugs and lamps and pilot lamp. The distribution panel contains two integrating watt-meters, three quick-brake double pole double-throw main switches, with interlocking device. From the generators and exciters all wires and cables are rnn under

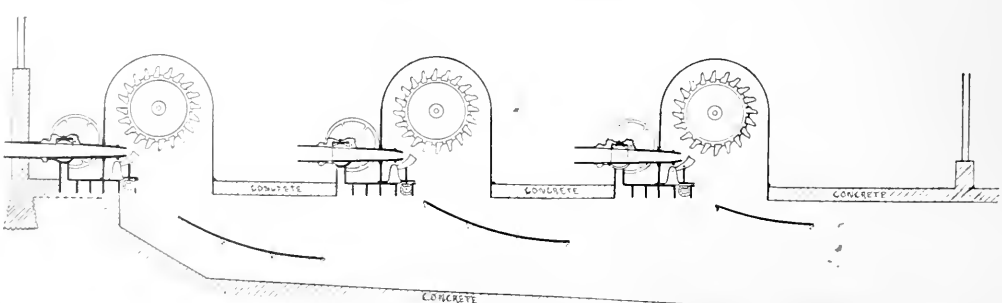



FIG. 3.—VERTICAL SECTION OF WATER WHEEL, WITH BAFFLE-PLATES AND TAIL-RACE.

the floor in conduits to the switchboard and from there in same manner to the raising transformers. The method of distribution will be better understood by referring to Fig. 5. The secondary wires lead from the top of the transformers to the addition on the westerly side of the power house where the high-tension switches are arranged, by means of which the current is delivered to the transmission line. The high voltage current is then conducted to the lightning arrester house about 25 feet west from the power house. This building contains three lightning arrester units, each consisting of six choke-coils in series with the line and 30 arresters mounted on a marble slab.

THE POLE LINE.

From the lightning arrester house the current is delivered on to the transmission line, consisting of three medium copper wires No. 2 B. & S. gauge, arranged in in the form of an equilateral triangle, one wire being mounted at the top of the pole and the other two on a cross-arm of 3x4 Oregon pine. Eucalyptus pins, boiled in oil, are used to support the 7-inch tripple-petticoated glass insulators, which in turn support the transmission wires. The cross-arms are bolted to the poles and have a bolt through the ends to prevent splitting as well as to hold the pins in the arms. The top pin is secured by two nails driven through the iron band which is used to prevent the top of the pole from splitting.

About twenty-one miles from the power house the line is branched, one line going to Porterville, 21 miles distant, and the other via Visalia to Tulare, 20 miles distant. From the junction point to Visalia the wire is reduced in size to No. 5 B. & S. gauge and from Visalia to Tulare it is reduced to No. 6 B. & S. gauge. The total length of the line is 62 miles.

The poles are 26 feet long, 5x5 at the top and 9x9 at the bottom. For road crossings and in the towns their length is increased to 35 and 40 feet. The pole line is equipped with six pine cross-arms, 30 inches below the power circuit, for telephone purposes.

THE SUB-STATIONS.

Sub-stations have been established at Visalia, Tulare, Exeter, Lindsay and Porterville, each having a complete equipment of lightning arresters, high-tension fuse switches, step-down transformers, etc. Views of the interiors of the Visalia and Tulare sub-stations are shown in Figs. 8 and 9. The primaries of the step-down transformers are arranged with the coils divided in the centre for parallel or series connection, the same as the step-up transformers, for 15,000 or 30,000 volts, allowance being made for line drop. The secondaries have ten leads brought out, with terminal blocks, giving a range of from 1,930 to 2,280 volts, which is a valuable feature and has proven to be very satisfactory and useful, affording a ready means of changing the secondary voltage to meet the requirements caused by changes in the proportions in the loads at the various sub-stations The transformers are of the Westinghouse oil-insulated, air-cooled type, in units of 50 kilowatts and 75 kilowatts, transforming from three-phase to two-phase, two transformers therefore constituting a "bank." The distribution of the light and power is at 2,000 volts, two-phase current.

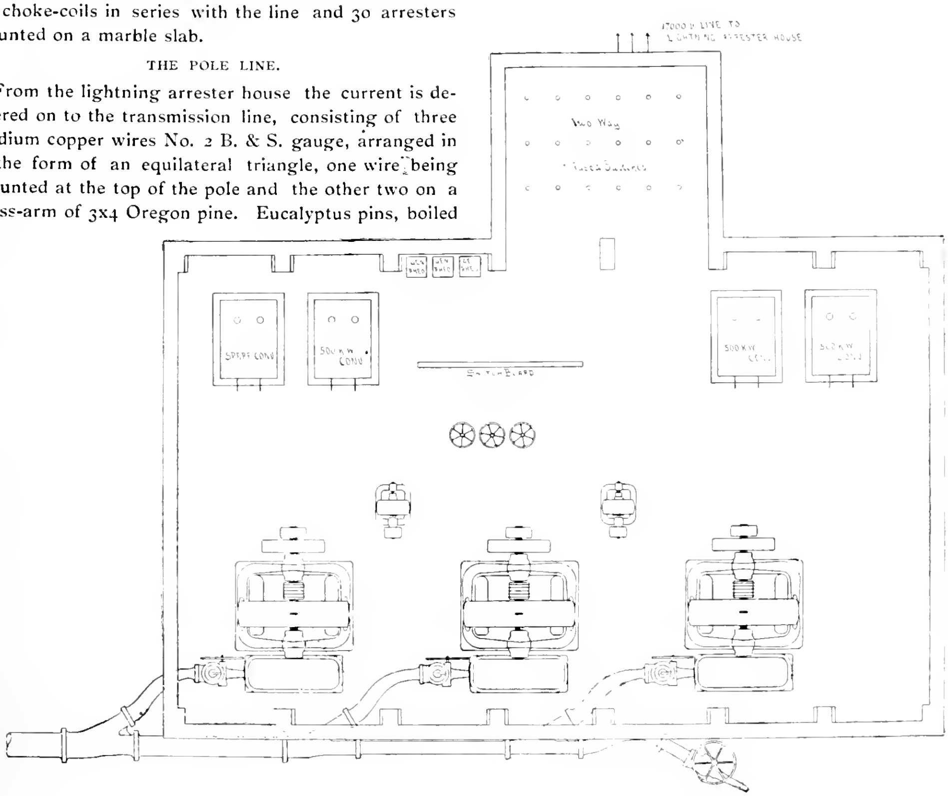


FIG. 4.—GROUND PLAN OF MOUNT WHITNEY POWER HOUSE.

The Visalia sub-station contains a 30-light arc machine for street lighting, driven by a 20 horse power induction motor, the incandescent lighting system being supplied direct from the 2,000 volt distribution and pole transformers to 104-volt secondaries. About 150 horse power is used from this station for lighting and a similar amount for operating induction motors for power purposes. In the Tulare station are two transformers of 75 k. w. each, and about 50 horse power is furnished to operate the water works and about 40 horse power for the local incandescent lighting system. The Lindsay station contains four transformers of 75 h. p. each, and furnishes 200 horse power for lighting and for

operating pumping plants for irrigation, electric power having superseded steam and oil engines for driving the centrifugal pumps. The experience with the motors is said to have been satisfactory that many new installations are being contracted for. About 110 horse power is furnished by the Porterville station, in which there are installed four transformers of 50 k. w. each, also choke-coils and lightning arresters, the same as at the power house. In the Exeter station there are two transformers of 50 h. p. each.

The company has fixed the rate for current at $50 per horse power per year, delivered to the step-down transformers of the customer on his premises, measurement by wattmeter at transformer primaries.

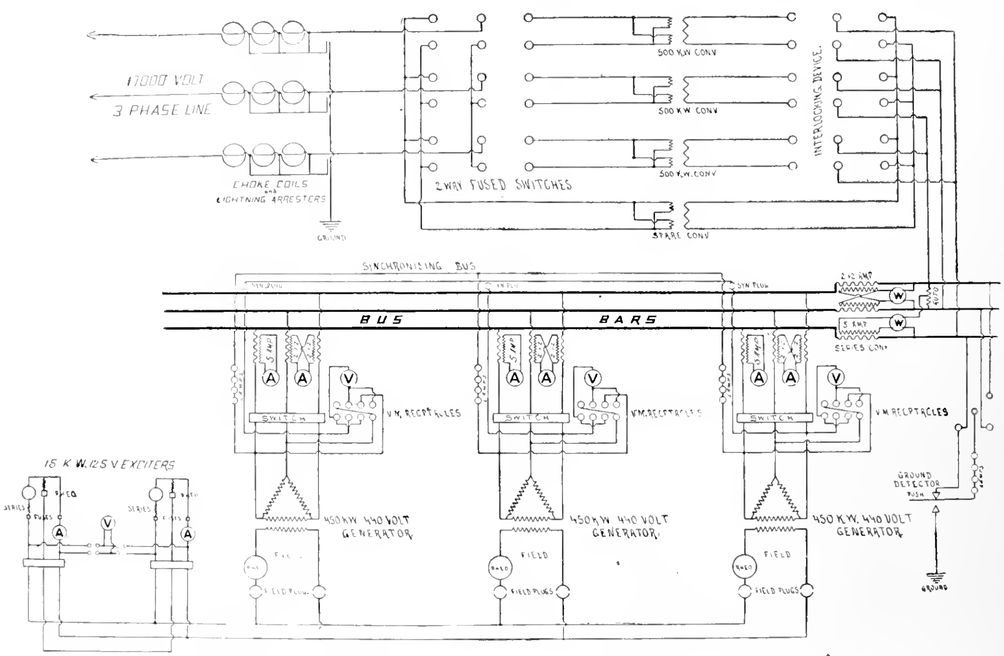



FIG. 5.—GENERAL WIRING SCHEME, SHOWING METHOD OF THROWING SPARE TRANSFORMER ON TO EITHER LEG OF TRANSFORMER.

The interesting features of the above plant are the high head used, the method of mounting the water wheel, armature and fly-wheel on a single set of bearings, and the fact that it is the first large electric transmission plant to be equipped with ellipsoidal water wheels. The means adopted for throwing a spare transformer into service in the event of either of the raising transformers at the power house becoming disabled is also a unique feature.

The entire electrical equipment of the Mount Whitney transmission plant was furnished and installed by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa.

## USE OF LOW CANDLE-POWER INCANDESCENT LAMPS.

W. M. STINE, in Western Electrician.

THIS article has to do with some of the minor economies that should be considered by those operating plants which do house-to-house lighting. Abroad it is customary to use for such lighting lamps of 8 or 10 candles, while in this country the usual practice leads to placing candles or even higher illuminating powers indiscriminately on all circuits without proper consideration for the service expected from them. The life of the lamp, too, is a consideration that is given much weight, the tendency being to place stress on considerable length of life, without regard to economy of operation.

When it is necessary to push house-to-house lighting on meter rates to obtain a paying station load and a sufficient return from a line, there is encountered a large class of patrons who are not able to use electric lighting in their homes unless it can compete closely with gas. The convenience of the electric light is conceded, but the persons to whom reference is made are not in position to pay for it. This class of business is desirable where the houses are near together and a sufficiently large number of patrons among them can be secured.

The average station manager pays too little attention to the satisfaction which his service is giving the small consumers ; he is satisfied when the house is wired and the lamps are in place and the voltage well maintained. Then, again, a 16 or 25-candle lamp requires more energy to operate it, and the position is thoughtlessly taken that such lamps will yield larger monthly bills. On the part of the patron, however, after the novelty of the service has worn off, in the course of a few months, the amount of the lighting bill becomes of more consequence than the convenience of the service. Gradually a lamp is dispensed with in the hall, and others where least needed, and then, one lamp after another being replaced with oil or gas, the patronage of electric lighting is finally lost.

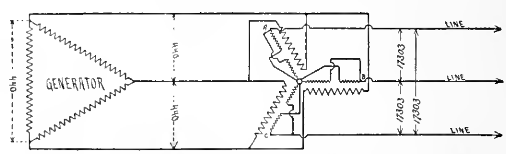



FIG. 6.—CONNECTIONS OF THE STEP-UP TRANSFORMERS.

This small house-to-house business can be made to pay and will succeed if the management is sufficiently enterprising. At the very outset, however, it must be conceded that the electric light bill must not greatly exceed an equivalent gas bill. The second concession must be that the patron's house shall be well lighted. In order to accomplish this, small light units are to be used operated at a high efficiency. In a small hall, for instance, a four candle-power lamp will yield sufficient illumination, and its maintenance will prove such a small item that patrons will keep lights of this size continuously lighted. Similarly, such small lamps can be used in closets, the cellar, and many places where but little light is needed. In this way the halls and passageways about the house will be well lighted and cheerful instead of dark and forbidding, as is usually the case in an electrically lighted house.

But it is especially in the living rooms that attention should be given to the size of the light unit. Here, too, the question of the quality of the light is of as great importance as its intensity. In many cases a 16-candle low-efficiency lamp is used, which proves a poor and an expensive light for reading from the fact that it yields a very yellow light. Then, too, in chandeliers, two or three 16-candle lamps are often used where equally good diffusion of the light and sufficiently intense illumination could be obtained by replacing these lamps with others of eight or ten candles.

FIG. 7.—POWER HOUSE, POLE LINE AND PORTION OF FLUME.

Coming to the main question at issue, economy and satisfactory service are secured for the patron by operating the lamps at a high efficiency. In spite of all that has been written on the subject, buyers of incandescent lamps still insist on great length of life. Though desirable in itself, in the present state of the art it should not be insisted upon.

An extreme case will be taken as an illustration. For reading purposes a 16 candle power light source is required. This admits of sufficiently intense illumination for comfortable reading at a distance of 7 or 8 feet. Bearing in mind that lamp-makers are obliged to gauge their product to a low efficiency standard to meet the demand for long life, the lamp in question will be considered to be operated at a much higher efficiency than its rating, which, it must be remembered, is in a sense arbitrary; and in this way one secures the desired whiteness of light and effects a great economy in its operation. By using a nominal 8 candle-power lamp at 50 volts on the circuit in question and operating it at a higher voltage there results:

| | Volts. | Watts. |
|---|---|---|
| Lamp burning at 8 candles requires.... | 50 | 28 |
| Lamp burning at 13 candles requires..... | 55 | 34 |
| Lamp burning at 15.5 candles requires... | 56 | 36 |

If this lamp has replaced a nominal 16 candle power one at 55 watts, when it is operated at 55 volts and yielding 13 candles of white light it will prove as effective as the displaced yellow lighting. In point of economy the lighting is now done for 62 per cent. of the usual cost, or 23 watt hours are saved each hour it is in use. Taking the by-no-means uncommon meter charge of 0.02 cent for the watt hour, this saving for each hour amounts to 0.46 cent. At a cost of 20 cents for lamp renewals the cost of the lamp would be saved in 44 hours of use. It is well known that lamps operated at a high temperature will blacken quickly and rapidly lose in candle power. This is especially true of a black filament; but if a well flashed lamp of low emissivity and bright gray color of the filament is selected, thus operating it will give a useful life of at least 300 hours, though the writer has had some lamps to show a record of 500 to 800 useful lamp hours, when operated at this excess in pressure, before showing too great candle power drop.

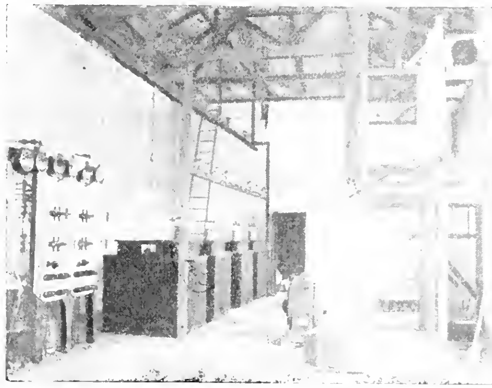


FIG. 8.—INTERIOR OF VISALIA SUB-STATION.

Taking 300 hours, however, as the basis for renewals, the saving will pay for the renewal and leave a balance of $1.15 and for better light service. But it is possible to operate the lamp at 56 volts, thus getting the full 16 candle power equivalent, the cost in this case being about 65 per cent. of the normal 16 candle power lamp.

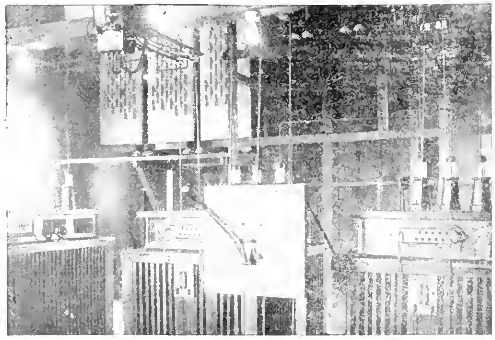


FIG. 9.—INTERIOR OF PORTION OF LINDSAY SUB-STATION.

This matter is one which calls for the exercise of intelligent care on the part of the manager of the plant. Some makes of lamps would not give good results under this treatment. It is emphasized that the filament must be well flashed and have a bright gray and polished appearance, and the exhaustion of the bulb must be thorough.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2299.



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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such unde standing exists, will be continued until instructions to discontinue are received and all arrearages paid.

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The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

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**The "Canadian Electrical News" has been appointed the official pape of the Canadian Electrical Association.**

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**Amendments to the Conmee Bill.**

RECENT events in the Ontario Legislature have been fraught with more than usual interest for the electrical fraternity, inasmuch as several amendments to the Conmee Bill, passed at the session of 1899, were proposed. Some of the amendments were desirable, namely, those intended to improve the working of the Bill; some others, which changed in important respects the principles of the Bill, were objectionable. The Legislative Committee of the Canadian Electrical Association therefore felt called upon to take action to prevent the possible destruction of the usefulness of the Act, while, at the same time, it was prepared to aid in making the Act more workable. The Conmee Bill was attacked or affected from several directions, first, the Graham Bill; second, Mr. J. J. Foy's Bill; third, Dr. Bridgeland's Bill; and fourth, Mr. Lumsden's Bill. From the outset it was evident that the principal Bill was the Graham Bill, which contained some favorable and some unfavorable features. No purpose would be served by going into the details of the various clauses which would have affected the principles of the Conmee Bill; suffice to say that the objectionable features of the Bill were successfully opposed by the Legislative Committee, while, at the same time, the Committee supported other features of the Bill. The final outcome was the adoption of the following amendments, namely, to give municipalities the option of making the principal and interest of their debentures payable in equal annual instalments, as well as of making the debentures payable by means of a sinking fund, as in the original bill; to allow municipalities three months, instead of one, to withdraw from their offer or reject an award for the taking over of a plant; to make it optional for a municipality and a company to agree on a single arbitrator other than the official arbitrator. These amendments, it is admitted, will improve the workableness of, and facilitate procedure under, the Conmee Bill. The provision to allow municipalities three month's time to reject their offer or an award will place corporations in a position to submit the question to a vote of the municipal electors. Mr. Foy's Bill proposed to exempt the city of Toronto from the operations of the Conmee Bill. This measure was defeated in the Municipal Committee. The object of Dr. Bridgeland's Bill was to give authority to municipalities which develop water powers to dispose of surplus current for furnishing power. This was in part opposed by the Legislative Committee. The Legislature finally accepted Dr. Bridgeland's Bill, with some modifications. The design of Mr. Lumsdem's Bill was to repeal the Conmee Act, but its reception was not favorable, a second reading being unanimously refused in the House.

Reverting to the Conmee Bill, the feeling of the members of the House seemed to be that the legislation had not been given a fair trial, and that it would be unreasonable to alter the vital principles of the Bill until this had been done. It is a matter of congratulation that the Legislature has again approved, with practical unanimity, of the justice and fairness, both to municipalities and companies, of the principles of the Conmee Bill. The opposition encountered can scarcely be considered as antagonistic, inasmuch as the author of the Graham bill pronounced himself to be in sympathy with the leading principles involved in the Conmee Act. He frankly stated that the object of his Bill was to improve the working of the Conmee Bill and to make certain

parts of it more clear. Nor can it be said that the members of municipal corporations are generally opposed to the measure. The municipal authorities apparently believed that its operation could be improved, but they did not seek to oppose the Bill itself. It is possible that in the future experience may suggest further amendments which may be made with advantage to all concerned. It might be pointed out that it is manifestly in the interests of electric lighting companies, not to place obstacles in the path of the Conmee Bill, but as far as possible to assist in facilitating its proper working, for, while the valuation clauses of the Bill will give the companies merely the barest actual value for their plant, and that without profits, yet, in the event of a municipality purchasing, that is better for the companies than leaving their property exposed, as under the former law, to ruin without compensation. Municipalities are not showing antagonism to the Conmee Bill, and nothing can be accomplished by companies pursuing a policy of antagonism to the municipalities. When a company is approached by a municipality with a view to the purchase of its plant, we believe it is advisable to deal with the offer in a fair, business-like spirit, and to throw no technical obstacles in the way of an amicable and equitable arrangement.

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The electric lighting interests of the province are deeply indebted to the Canadian Electrical Association for the attention it has given to the legislation in question. The Legislative Committee has now become an important section of the Association. Although the work of this committee has been accomplished within two years, yet in this brief period legislation has been enacted which, while it does no injustice to municipalities, prevents the property of lighting companies from being exposed to confiscation. The benefits of the efforts of the Association do not accrue to its members only, but every lighting company in the province is placed under its protection. The Association is, therefore, deserving of hearty support.

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**Electricity in Mining.**

In its application to mining purposes electricity enters upon perhaps the most exacting and varied field which it is possible to conceive of, as all classes of transportation and haulage make their very exacting demands, and the applications to lighting, power for fans, drills, compressors, pumps, cutters, etc., are certainly wide enough to provide scope for all classes of apparatus. If, then, in this comprehensive field of application there still remain a few demands which electricity does not fill in an entirely satisfactory way at present, the reason will probably be found in the fact that these applications have been somewhat neglected by an art which has had such tremendous fields open to it in other directions. However, the fact remains that within a few years nearly every application of power to mining work has been successfully met by electric power, and a review of the situation at the present should prove to be both interesting and instructive.

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The field invaded by electric power had been held, up till its advent, by steam and compressed air. The steam engine being a prime mover, still holds its place for developing the power, and must of necessity continue to do so unless superseded in certain cases by water wheels or gas engines, but in the transmission, distribution and application of the power developed by the prime mover, the steam, compressed air, and electricity are directly comparable. Steam distribution will obviously only be used where steam is the prime mover, while in the case of water power or gas the distribution will be by means of air or electricity. The question of gas engines for power generation in certain localities where the cost of coal is excessive is receiving attention, owing to the better heat efficiency of the gas engine and the value of the by-products of the gas manufacture. But in most mines economy is not the first consideration. Even in this case, however, the obvious advantages of electricity will render its use for lighting almost imperative.

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The power demands for mining purposes may be generally grouped in four divisions, lighting, traction and haulage, power for fans, pumps, etc., and for drills and cutters. So far as lighting is concerned, no question can arise as to the superior advantages of electricity, its flexibility, safety in gassy mines, coolness, and freedom from flame and simplicity of transmission rendering it incomparably better than any other form of illuminant. With regard to traction and haulage, its only rivals are that ancient motor, the mule and cable traction. The first will probably always find a place in the workings in the vicinity of the faces being operated upon, while the rope and electric traction compete for the haulage of trains in the tunnels and outer works. Without dealing in detail with the advantages of electric over rope haulage, it may be pointed out that in the modern mine the former is almost exclusively occupying the field, except in cases where excessive grades render cable traction a necessity, and even in these cases electric motors are available for driving the cable drums. It is in its application to the general power demands for pumps, fans, hoisting, etc., that the flexibility and readiness of application of electric power becomes overwhelmingly apparent, allowing as it does the establishment of motors in out of the way places, and permitting its use for temporary demands without excessive installation costs, and also the ability to manipulate the apparatus from a distance is often of great value. No better illustration of the use of electric power for these purposes can be had than that afforded by an inspection of the camp at Rossland, where power is supplied from a distance of thirty-one miles by the West Kootenay Power and Light Company, and applied by means of about three thousand horse power in motors to the mines in the vicinity. Among the most striking applications in this camp is that for hoisting. Several hoists are in operation, the largest being driven by a three hundred horse power motor, raising ore from a 750 foot level. The motor is a three phase induction machine, directly connected to a double drum hoist capable of raising eight tons at a speed of 700 feet per minute. In connection with the same mine a compresser is driven by a 400 h.p. three phase synchronous motor. In other mines in Rossland similar but smaller machinery is used for the same and many other purposes, and the regulation on the lighting circuits is remarkably good when the effect is considered of so large a motor load with such variable demands as hoisting at the end of a thirty-one mile transmission line.

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It is in the use of electricity for the operation of drills, coal cutters, etc., that questions may arise as to

its value as compared with other powers. So far as the transmission is concerned, it still retains its superiority, and also as regards its flexibility and general simplicity, but, although in electric drills great advances have been made since their first application, the air drill still holds its own. It should be remembered, however, that not all of the favor with which the air drill is regarded is due to its superiority as a mechanism, but to the personal consideration that the exhaust from the drills furnishes fresh air to the workings, which it is practically impossible to obtain in such places by the general ventilating system. Further than this, consideration must be paid to the conservatism of the miner who is used to the vagaries of the air drill and who does not generally relish the acquiring of any fresh knowledge of newer apparatus, especially when it does not add to his comfort under conditions which are trying at the best. The electric drills in use may be divided into rotary and reciprocating types. The first, by reason of the direct application of motors, appears to present fewer difficulties in construction, while the latter, in attempting to imitate the percussion drill by the direct attraction of solenoids, introduce trouble of its own which it may be safely said have not been overcome up to the present. Again, the more successful of the latter class require the use of special electrical generators giving suitable current waves which cannot be used for the general power distribution. It short, the drilling appears to be largely in the hands of the air drill at the present time, in spite of many attempts to displace it, and in view of past experience the outlook is not at present very hopeful for electric drilling. As regards coal cutters, which are of considerable variety, electricity, owing to its flexibility and simplicity, can be very readily applied with success, and failures of the cutting apparatus, which have been pretty frequent in the past, cannot be laid to its charge. Several successful types of electrically driven cutters are at present in the market, and as one machine with two operators will displace from twenty to thirty men on the coal face, these will inevitably be more generally applied. The chief objection which is made to the use of cutters is due to the fact that, with the methods of laying out the coal faces which are adopted for hand cutting, machine cutting brings down the coal in such quantities that it cannot be carried away quickly enough, thus limiting the possible output of the machine.

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The most desirable system of generation and distribution of electricity will obviously be one which will lend itself best to the general requirements, and as it may not be possible to meet each of the separate demands in the best manner with one system, a compromise may have to be made, giving first consideration to the most important. For flexibility, an alternating system will appeal to the engineer in most cases, and owing to improvements in motors operated on this system, every requirement for mining work can be met with the exception of traction and some forms of drills. At the present direct current haulage holds the field, chiefly because the alternating motor has not been designed to meet the conditions imposed by mining traction, and also because the phased currents adopted require a double trolley line, which in the narrow and low tunnels would be prohibited, from its complication and danger. The latter appears to be the greater difficulty, as the application of alternating current motors to traction purposes appears to be solved for surface tramways, and the special application to mining work should present no insuperable difficulties. In many cases a direct current plant and distribution (which will be suitable for all purposes) can be used where the distances are not great and where no motors are to be located in gassy parts of the mines, but in general the low distribution voltage imposed by mining work heavily handicaps the direct current. In any case, for all mining purposes, except traction, the alternating current motor is more simple and reliable than the direct current, chiefly owing to the fact that no commutator is required which may flash, become dirty and require cleaning, which no mining motor ever gets. It appears probable that the alternating current systems will prevail finally for all purposes, but at the present a composite plant giving alternating and direct currents appears to be necessary if electric traction be required. This, however, is not so complicated as it looks, for with double current generators in the station either direct or alternating current can be had without complicating the plant. As regards the distribution of power, owing to the adverse conditions which prevail in mining work underground, a potential of more than 270 volts is not advisable on trolley wires which are within possible reach or on motors and other appliances which are to be handled. Owing to the dampness and presence of destructive minerals in the water, which is generally in evidence, insulations are rapidly corroded unless thoroughly protected, and it appears advisable in many cases to adopt bare wires thoroughly insulated from ground and each other by non-corrodable supports for the low voltage wiring, and armoured cables laid in dry places and out of reach for the transmission lines. The use of iron piping through which the cables can be drawn is usual in shafts and places where injury might occur through falling materials. In gassy mines safety cables are sometimes used which are designed so that the circuit is opened at the switchboard in case the cable is cut by falling rocks, so that no arc is formed in the mine. These generally require some form of supplementary circuit, which is objectionable, and it appears that ordinary concentric cables should meet the conditions of safety when it is considered that it is almost impossible to cut one of these without short-circuiting the cable, which would open the circuit-breaker in the station. In gassy mines, of course, gas tight or oil switches are used, and machines with commutators present more elements of danger than those without.

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Summing up the advantages and disadvantages of electricity, steam and air, it may be said that steam distribution and utilization is expensive to install and maintain, is inefficient by reason of radiation and condensation, requires provision to be made for exhaust steam, heats up the mine, and rots the timbering. Air transmission and utilization of power is greatly superior to steam, and is generally used, but pipe lines are expensive to install, their deterioration is great, and there is not the requisite flexibility to meet the temporary character of the installations in the workings. Further, both of the above systems must be supplemented by an electric lighting plant. Electricity for mining purposes possesses in a remarkable degree the necessary flexibility and adaptability to meet the conditions. Maintenance is small, the attendance required is slight, and the same plant is used for the lighting as for the power requirements. The drill situation, however, is not altogether satisfactory, but the time for development of that particular application has been short, and there is good reason to think that the advantages of electric power for all purposes will soon improve that application and make it thoroughly satisfactory.

## MR. JULES BOURBONNIERE.

The features of Mr. Jules Bourbonniere, manager and secretary of the Imperial Electric Light Company of Montreal, are portrayed on this page. Mr. Bourbonniere graduated with distinction from the Catholic Commercial Academy in Montreal in the year 1884, and immediately thereafter engaged as bookkeeper with the firm of Mailloux & Barsalou, wholesale hardware, Montreal, which position he occupied for four years. He then became manager, for two years, of Alfred Truteau's biscuit factory, and after spending two years as secretary-treasurer of the Farnham Beet Root Sugar Company (Baron Seillieres) at Farnham, Que., undertook the management of Israel Charbonneau's sash and door factory at Mile End, a suburb of Montreal.

In May, 1894, Mr. Bourbonniere entered the services of the St. Jean Baptiste Electric Company, of Montreal, as chief accountant and secretary. When the St. Jean Baptiste Electric Company was re-organized, in December, 1895, he was entrusted with the dual functions of manager and secretary of the new organization,

Mr. Jules Bourbonniere.

called the Imperial Electric Light Company, which position he still retains. The above company, judging by its annual dividends, is prospering financially, and claims to have a monopoly of commercial lighting in Eastern Montreal. Mr. Bourbonniere is only 31 years of age. He is married, and has a family of three future electricians.

It is whispered that Mr. Bourbonniere has been offered the management of a large water power plant. We shall be pleased to learn of his continued success.

## NEW INCANDESCENT LAMP.

Edison has brought out a new incandescent electric lamp for high tension currents. It is made of a mixture of rare earths in a porous form, with carbon dust. The current, under the high pressure, leaps from particle to particle of the carbon dust. The earth used is thoria or zirconia, and the whole is dipped in a solution of acetate of thoria, so as to make a coating which shall incandesce brightly when the whole filament is brought to a high temperature by the action of the current. He also makes filaments by impregnating a thread of cotton wool, carbonising it, and then thickening the coating of oxide on it.

## COST OF ELECTRICITY IN BUILDINGS.

It is generally assumed that electricity can be supplied to buildings more cheaply than it can be generated by isolated plants, but that this is not always the case is shown, says the Engineering Magazine, in a carefully prepared paper read before the American Institute of Electrical Engineers by Mr. Percival R. Moses.

Mr. Moses has collected information from more than a hundred buildings of various sizes and types, and from these he has selected those from which the information was furnished with such a degree of detail as to render the conclusions reliable. The buildings selected include hotels, office buildings, loft buildings, department stores, and apartment houses, all in the city of New York, and since liberal access to the books of the establishments was permitted the data are of much interest.

In the investigation of the buildings the hourly variations in the demand for light and power were plotted in the form of curves, and in each case a proportional allowance made for depreciation, interest, and other fixed charges. A typical building was taken in each case, and as these cases include actual records of the cost of supplying the same buildings, under the same conditions, with electricity, both from their own isolated plants and by the central station, it certainly appears as if the comparisons have been made upon a fair basis.

In considering the isolated plant it must be remembered that in nearly, if not all, such buildings a steam power plant must be maintained in any case, or at least steam must be used for heating, and if the steam power does not provide sufficient exhaust steam to warm the building, live steam must be used. The installation of an isolated electrical plant is therefore only a partial increase in operating expense, in such cases, and not so great as it would be if the entire power plant had to be placed solely for the operation of the electric machinery.

We give here only the conclusions which Mr. Moses draws from each building considered by him, and the full data in each case will be found in his original paper. Taking a table which Mr. Moses has prepared for buildings using approximately from 825,000 kilowatt-hours per annum down to 40,000 kilowatt-hours, he shows that the costs per kilowatt-hour for isolated plants are as follows :

| | |
|---|---|
| Large Hotel | 1.66 cents |
| Small Hotel | 2.45 " |
| Apartments | 4.70 " |
| Department Store | 2.85 " |
| Small Store | 4.10 " |
| Large Office Building | 4.37 " |
| Small Office Building | 5.06 " |
| Loft Building | 2.60 " |

When it is understood that the charges by the central station company, taken from the published reports, are, on an average, 10.6 cents per kilowatt-hour, and that the cost of production is about half this, it appears that under existing conditions in New York the private consumer can generate electricity at about the same cost, or even less cost than the central company, and that there is a manifest economy in the installation of the isolated electric plant.

The Lachine Rapids Hydraulic and Land Co. has within the last three months installed four generators fron the works of the Canadian General Electric Co., Peterboro. These will increase the capacity of the plant by 4,000 h. p. The Lachine Company have recently made some changes in the method of driving the exciters at the power house, they now being driven by independent wheels.

## THE GAS ENGINE VS. THE STEAM ENGINE.

A LEADING manufacturer of both gas and steam engines holds the opinion that a correct answer to the question, what is the comparative cost of operating a gas engine and a steam engine of equal power, involves a special solution for each individual problem. He says: Considered solely as a machine for converting the total energy of the fuel into mechanical work, the gas engine is far the more efficient. There are gas engines in operation which transform over 25 per cent. of the heat in the fuel into useful work, while in the very best recorded performance of the steam engine barely 14 per cent. of the energy in the coal burned has been thus accounted for, and in the average steam plant, not to exceed 5 per cent. There are many small plants, consisting of common slide valve engines, with uneconomical types of boilers, in which less than 2 per cent. of the energy of the coal burned is converted into mechanical work. At the same time it must be remembered that a given number of heat units in the form of fuel suitable for use in a gas engine costs more than an equal number in the shape of coal or other ordinary fuel suitable for burning in a common boiler furnace. As a general proposition it may be assumed that in a plant which operates continuously the item of fuel alone will be somewhat greater for the gas engine than for an improved type of modern steam engine, except possibly in the case of an engine running on producer gas. When the service is of an intermittent nature, or the power is required only for a comparatively short time each day, this difference in favor of the steam engine becomes less, and may even become a balance in favor of the gas engine, for the reason that in the gas engine plant there are no 'stand-by losses,' i.e., radiation and leakage when standing idle under full steam pressure, and coal burned in banking fires and raising steam. With the gas engine the fuel expense starts and stops with the engine. But the fuel cost is only one item in the cost of producing power. One must consider the value of the additional space and buildings required for a boiler plant; the cost of a stack; depreciation, repairs and insurance on a boiler plant. The gas engine has a field of its own which cannot be occupied by the steam engine, and there is no immediate prospect of the gas engine seriously encroaching on the legitimate field of the steam engine.

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The Sherbrooke Gas and Electric Co., Sherbrooke, Que., are increasing their station capacity, and have placed an order with the Royal Electric Co., of Montreal, for a 500 k.w. S.K.C. two phase inductor type generator.

A unique blotter has been sent out bearing the compliments of Messrs. Sadler & Haworth, manufacturers of oak tanned leather belting, Toronto and Montreal. The blotters are held together by a celluloid button bearing an illustration of the Union Jack, while the name of the firm is inscribed on a fine sheet of celluloid covering the blotters.

## THE VOLTA STORAGE BATTERY.

THE following description of the Volta storage battery is found in the prospectus of the Volta Electric Storage Company, of Hamilton, an illustration of whose works is presented herewith:

The problem of intercepting and retaining electrical energy is receiving its latest and fullest development in the adaptation of the original pile of Volta to the purpose of storage. Of course, the suggestion carries with it the necessity of upsetting and rearranging our ideas of storage battery construction. The excess of sulphuric acid electrolyte must go, but with it goes unnecessary weight, and one of the greatest inducements to sulphating that any cell arrangement can offer to the lead plates or grids. The containing sell must go, but with it goes also weight and space. The knowledge that a single plate may be an element must come, but with it comes the greatest possible compactness, and also an unlimited flexibility of application to all purposes for which electrical energy can be applied. The facility with which this metallic plate construction of Volta lends itself to the necessary variations required for the purpose of storage is remarkable. In fact, it largely consists in the constructing of the reservoir. The porous lead as applied is the analogue of the zinc, and the lead plate that of the copper, or the conducting side of the disk. It only remains, therefore, to increase the capacity of the porous lead so as to absorb more hydrogen, and to add the peroxide to the face of the opposite side of the sheet lead, to enable it to absorb more oxygen; and then to place between contiguous plates a moisture-absorbing material of sufficient capacity to furnish the electrolyte for producing the gases; and the thing is accomplished. Theoretically, therefore, we should expect to find more electrical energy per 100 lbs. of weight carried, and per cubic foot of space occupied, in such a reservoir than in one constructed on the plan of Plante and Faure, or in any other variation of the two volt Plante type.


WORKS OF THE VOLTA ELECTRIC STORAGE CO., HAMILTON, ONT.

An inspection of the accompanying illustrations will serve to certify us that the theoretical presumption is well borne out by facts. In the first place, there is no containing cell used in this high tension construction, whereas in the Plante there must be one containing cell for every two volt element. This containing cell, of course, must be greater than the mere superfices of the element; and we also know that this space must be filled with electrolyte. This combination increases both space and weight. Again, in each cell of the Plante type, there must be two lead terminals, carried well up above the surface of the acid, taking up still further space. In the high tension pile, on the other hand, these are eliminated; there being but two terminals even should the potential of the pile be carried to 100 or more volts. In the illustration shown the normal potential is 28 volts, while there are but two terminals—one from the bottom plate, "the positive," and one from the top plate, "the negative." The path of the charging current is from the positive up, directly through the pile to the negative. This pile,

with an energy capacity of 100 ampere hours, and 28 volts normal potential, is contained in a space 11½ inches wide by 28 inches in length and 11 inches in height, equal to a little more than two cubic feet, for approximately four h. p. hours of energy, and with a weight of 240 lbs. total, or one h.p. for every 60 lbs. of weight carried. Where piles are built in larger units, both weight and space are reduced still further. Four such, piles occupying a space 28 inches wide by 44 inches long and 11 inches high will furnish current for twelve 16 candle power 110 volt lamps for 15 hours. In other words, a space 28 inches wide and less than four feet long and 12 inches high will furnish sufficient room for holding a battery to light an ordinary building burning 12 lamps 5 nights of 3 hours each. The cost also, in proportion to ordinary storage plants, is very greatly reduced, such a plant costing the user $240.

The accompanying plates show two curves, Fig. 2 representing the drop in potential of a single plate, or element, of this size during a discharge of 100 ampere hours, at a 7 ampere rate ; the second, Fig. 3, representing a curve for the entire pile during the same discharge, showing a drop of 2 8/10 volts for the entire pile, or 2/10 per plate or element. This cut also shows the kinetic value of the pile in h. p. hours.

Among the noteworthy peculiarities of the high tension pile is, first, the fact that each plate is an element in itself, having a positive condition on one side of the plate and a negative condition on

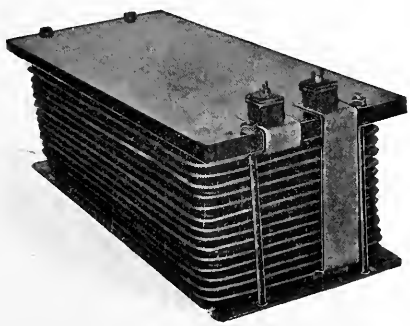

FIG. 1.—THE VOLTA STORAGE BATTERY.

the other side, for the potential difference in a plate at full charge of 2 2/10 volts from the surface of the positive active material to the surface of the negative active material. When, therefore, in a well constructed pile the circuit is disconnected, that is, the outside circuit unclosed, it is an impossibility to discharge a single plate, because the points of potential difference are separated by the metal plate, a solid septum through which the necessary translation of ions is impossible. When, however, the outside circuit is closed, then the potential difference is along the line of that circuit from the positive terminal of the pile to its negative, and the electrical action and molecular interchange is between the opposite sides of adjacent plates. Antoher peculiarity of this battery is that the fumes, which are an unavoidable and never failing attendant upon the Plante type of battery, compelling its installation in separate and specially prepared apartments, and often at great expense, are entirely absent, so that it is practicable to set it up in a machine shop, or even a living room without injurious results to person or property. The value of this last feature cannot be overestimated, and taken in connection with its great compactness, its comparatively light weight and its small cost, it completes the list of desirable qualities which go to make up the perfect storage plant for the markets of the world.

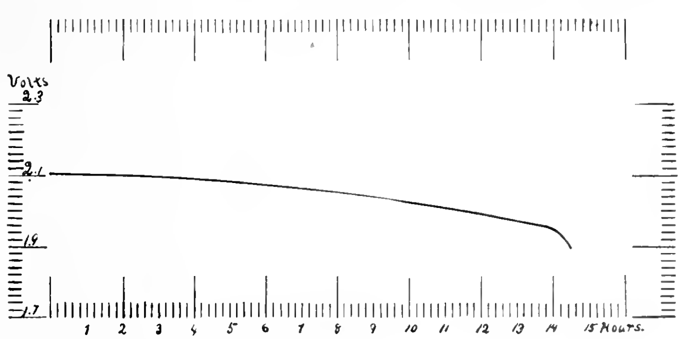


FIG. 3.

The Volta Electric Storage Co., Ltd., of Hamilton, Canada, are introducing these batteries for all such uses as indicated above, and for every other purpose for which electric current can be utilized. They are just now moving into their new building, from which they expect to supply the Dominion of Canada and also do a large export business.

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Articles of incorporation have been filed for a company which purposes operating electric and steam railways in Cuba. This company has a capital of $8,000,000, and one of the chief promoters is Sir William Van Horne.

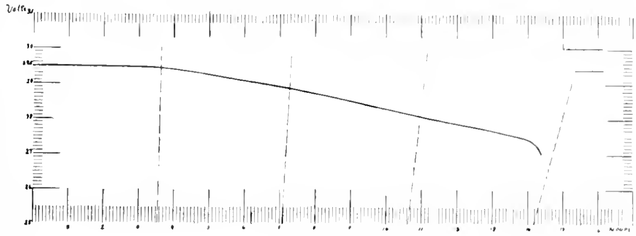


FIG. 2.

H. Walker & Sons, of Walkerville, Ont., have given a contract to the Michigan Electrical Co., of Detroit, for what is expected to be the most elaborate sign on the American continent. For the purposes of the sign, a separate iron structure on the river front, in rear of the offices of the firm, is being built. Between 4,000 and 5,000 four-candle power incandescent lights will be used. The letters will be clear, while colored lights will be shown in the border. It is estimated that 100 h.p. will be required to operate the lights.

An exhibition will be made in the Art Museum within a week or so of the result of work done by local students in the International Correspondence School of Scranton, Pa. This exhibition will be of special interest to local people, showing how far comparatively uneducated people may progress by improving spare moments in the study of lines of work in which they desire to perfect themselves. The Correspondence Schools interested in this exhibition have a remarkable following in this city, over 600 persons being enrolled as students here. The work covers almost every line in which working people are interested. An ambitious young man who has been forced to slight his common school education, turns to the courses offered by these schools, and, selecting the one in which he is most interested, begins the study. The plan of the courses pre-supposes only the ability to read and write. The first work is elementary, and the progress is gradual and possible only by becoming perfect in what has preceded. The student goes through the course, and at such a time as he completes the work receives a diploma, and the management of the schools is also interested in securing for the graduate better employment in keeping with his proficiency. The exhibition is made in the Art Museum at the suggestion of the City Library Association. In connection with the drawings, which will be largely of mechanical and architectural designs, the city library will have several shelves of books that are useful for reference in connection with the course given by the schools. It is hoped that those pursuing the studies may be interested in coming more frequently to the library.—Springfield Republican, March 26, 1900.

## COKE AS A STEAM FUEL.

THE advantages of coke over coal as a fuel for generating steam were discussed at the Montreal meeting of the Cotton Manufacturers' Association by Arthur C. Freeman, of Waltham, Mass., who offered the following suggestions as useful in learning its management :

(1). In building the fire, put the coke on lightly and often, until the fire is 7 or 8 inches thick ; an 8-inch fire will make steam much better than a heavier one.

(2). It is better not to disturb the top of a coke fire, therefore when firing spread the fuel evenly, so as to keep the fire level.

(3). Shaking bars are very suitable for burning coke, and they should be shaken frequently. If dead bars are used, a light poker should be run under the fire frequently to keep clinkers from clinging to the grate, and to keep them broken up. A poker is better than a slice bar for this purpose, as it is lighter and more easily handled. The object is not to bar up the fire, but to detach small pieces of clinker and prevent them from forming and running together.

(4). It is advisable to keep water in the ash pit, or to introduce a jet of steam.

In support of his position, Mr. Freeman presented the result of a test made by the Mutual Boiler Insurance Company of Boston on the comparative evaporative powers of coals and coke compared with the best soft coals.

## FRICTION ON STEAM PACKINGS.

BEFORE the meeting of the American Society of Mechanical Engineers in December, 1899, Mr. C. H. Benjamin, of Cleveland, Ohio, read a paper on the above subject, describing some experiments made at the Case school with several varieties of packings. He gives four tables showing the results, which we reproduce, together with his comment and general conclusions.

Table I gives a summary of the results, showing the average horse-power consumed by each packing box at varying pressures, and, for purpose of comparison, the power at 50 pounds pressure of steam. The friction of the machine has been reducted.

Table II shows the effect of tightening the gland nuts on the friction of the packing, and also the effect of oiling the rod.

In most of the experiments detailed in Table I the nuts were tightened with the fingers only, and then just enough to prevent leakage, and no lubricant was used except that incorporated in the packing itself. With some of the dry rubber packings it was necessary to use oil from the first. A good quality of cylinder oil was applied.

The effect of varying the steam pressure is best shown graphically, as in Tables III and IV. The numbers at the ends of the lines correspond to numbers used in the the other tables. The ordinates indicate the steam pressures observed, while the abscissas represent the horse-power cosnumed by each box. The points where these lines cut the line of 50 pounds pressure are those used for comparison of the different packings. It will be seen that the friction varies with the pressure in approximately straight line ratios in many of the cases.

### GENERAL CONCLUSIONS.

1. That the softer rubber and graphite packings, which are self-adjusting and self-lubricating, as in Nos. 2, 3, 7, 8, and 11, consume less power than the harder varieties. No. 17, the old braided flax style, gave very good results.

2. That oiling the rod will reduce the friction with any packing.

3. That there is almost no limit to the loss caused by the injudicious use of the monkey-wrench.

4. That the power loss varies almost directly with the steam pressure in the harder varieties, while it is approximately constant with the softer kinds.

The diameter of rod used—two inches—would be appropriate for engines of from 50 to 100 horse-power. The piston speed was about 140 feet per minute in the experiments, and the horse power varied from .036 to .400 at 50 pounds steam pressure, with a safe average for the softer class of packings of .07 horse-power.

At a piston speed of 600 feet per minute, the same friction would give a loss of from .154 to 1.71 with a working average of .30 horse-power, at a mean steam pressure of 50 pounds.

TABLE I.

| Kind o Packing. | No. of Trials. | Total Time of Run in Minutes. | Average Horse-Power Consumed by Each Box. | Horse-Power Consumed at 50 Pounds Pressure. | Remarks on Leakage, etc. |
|---|---|---|---|---|---|
| 1 | 5 | 22 | .091 | .085 | Moderate leakage. |
| 2 | 8 | 40 | .049 | .048 | Easily adjusted ; sligbt leakage. |
| 3 | 5 | 25 | .037 | .036 | Considerable leakage. |
| 4 | 5 | 25 | .159 | .176 | Leaked badly. |
| 5 | 5 | 25 | .095 | .081 | Oiling necessary ; leaked badly. |
| 6 | 5 | 25 | .368 | .400 | Moderate leakage. |
| 7 | 5 | 25 | .067 | .067 | Easily adjusted and no leakage |
| 8 | 5 | 25 | . 82 | .082 | Very satisfactory ; sligbt leakage. |
| 9 | 3 | 15 | .200 | .182 | Moderate leakage. |
| 10 | 3 | .. | .275 | .... | Excessive leakage. |
| 11 | 5 | 25 | .157 | .172 | Moderate leakage. |
| 12 | 5 | 25 | .266 | .330 | " " |
| 13 | 5 | 25 | .162 | .230 | No leakage ; oiling necessary. |
| 14 | 5 | 25 | .176 | .276 | Moderate leakage ; oiling necessary. |
| 15 | 5 | 25 | .233 | .255 | Difficult to adjust ; no leakage. |
| 16 | 5 | 25 | .292 | .210 | Oiling necessary ; no leakage. |
| 17 | 5 | 25 | .128 | .084 | No leakage. |

TABLE II.

| Kind of Packing. | Horse-power consumed by each box, when pressure was applied to Gland Nuts by a 7-inch wrench. | | | | | | Horse-power before and after oiling rod. | |
|---|---|---|---|---|---|---|---|---|
| | 5 Pounds. | 8 Pounds. | 10 Pounds. | 12 Pounds. | 14 Pounds. | 16 Pounds. | Dry. | Oiled. |
| 1 | .120 | .... | .136 | | | | | |
| 3 | .... | .... | ... | .... | ... | .... | .055 | .021 |
| 4 | .... | .248 | .... | .303 | .... | .390 | .154 | .123 |
| 5 | .... | .220 | | | | | | |
| 6 | .... | .348 | .430 | .... | ... | .... | .323 | .194 |
| 7 | .... | .126 | .228 | .2 0 | .230 | .340 | .067 | .053 |
| 8 | .. | .363 | .500 | .535 | .520 | .533 | .533 | .236 |
| 9 | .... | .166 | .... | .... | .... | .... | .666 | .636 |
| 11 | .... | .405 | .454 | .... | .... | .... | .454 | .176 |
| 12 | .... | .161 | .242 | .359 | .454 | .... | .454 | .122 |
| 13 | .... | .317 | .394 | .582 | | | | |
| 15 | .... | .526 | | | | | | |
| 16 | .... | .327 | .860 | | | | | |
| 17 | .... | .198 | .277 | .380 | | | | |

TABLE III.
VARYING STEAM PRESSURE
SCALE 1 INCH = 0.1 H. P.

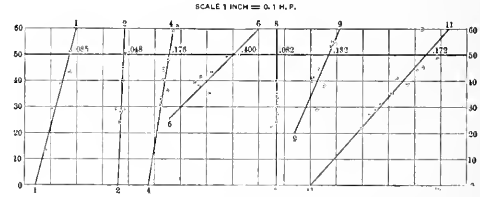
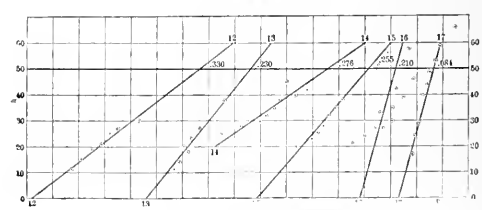


TABLE IV.
VARYING STEAM PRESSURE
SCALE 1 INCH = 0.1 H. P.



Mr. W. T. Steward, E.E., of Toronto, has furnished the town council of Woodstock, Ont., with a valuation of the electric light plant there, also an estimate of the cost of the installation of new and up-to-date machinery. The council contemplate municipal ownership and the remodelling of the plant.

## THE DEVELOPMENT OF INTERIOR CONDUIT.

A FEW years ago saw the advent of iron electrical conduit; and while the welcome extended was not enthusiastic, yet the superiority of the tube over the asphaltic paper raceway was so manifest that electrical engineers soon came to demand such an installation in all high class systems. Since the old time tube, whose part was purely one of insulation, we have advanced to the tube the whole object of which is protection to the wire, insulation being placed where it is most serviceable, viz., on the wire itself.

The mechanically strong raceway for electrical conductors was a gradual but rapid growth, progress in this branch of the electrical field being forced by real necessity; it was found that protection to the wire from external mechanical injury was required, and along that line went development. The conduit first in use was composed of paper, which tube was later placed on the market encased in thin sheet brass. This was a step consistent with the purpose to which conduit was put. But brass proved ineffectual, and later a conduit was introduced which for a short time acknowledged no superior; this tube, called "Armorite," is yet being used in large quantities, a few engineers preferring a combination of insulating and protecting qualities in the raceway. In construction, "Armorite" conduit is peculiar, a description of which is as follows: The lining is made from live kiln dried basswood, cut with tongue and groove in two semi-cylindrical sections. These sections are then treated under pressure with a product of petroleum, which operation causes the liquid to penetrate the pores of the wood, thus destroying the active properties and excluding gases and moisture. The two sections of wood are then placed together (over a mandrel), forming a complete tube, and forced into a steel armor. The object in putting the wooden tube within the iron in two sections is that the conduit may easily bend to any angle without affecting the pipe or wood lining. During the early days of the manufacture of this conduit, the steel armor was a very light pipe; but the electrical trade required a stronger tube, consequently the light armored type was abandoned and a conduit manufactured embracing more rigidity and strength. This was accomplished by cutting the wood lining for a heavier gauge pipe and encasing same in a tube of the thickness and strength of the ordinary form of commercial gas pipe.

Finally, crowning the efforts in this line, was the introduction of "Loricated" conduit, a strong iron pipe, coated both on internal and external surfaces with a glass-like non-fused enamel. To this point has improvement in interior conduits advanced. And, judging by the satisfaction evidenced wherever this enameled tube has been installed, an improvement is not desired, if, indeed, improvement is possible. It is claimed that the highest class work and the most secure system of wiring is obtained by the use of enameled iron armored conduit, and that "Loricated" conduit is installed in all the monster buildings erected to-day, buildings on which are engineering marvels and which are as nearly perfect as the science of the times can devise. Limiting electrical energy to its proper channel is now a problem solved; the wire is carefully braided, the conductor then being drawn into a protecting raceway of enameled conduit, of the strength as above explained.

The protectory capacity of the conduit may for convenience in considering the subject be stated to be, firstly, in shielding the wire from mechanical injury, which might be caused by external agencies; secondly, in offering fireproof protection from the wire which may become heated; thirdly, in affording the installer with a smooth interior to the raceway into which the wires may readily be drawn without in any way tearing or otherwise injuring the braiding of the wire. In encasing the wire within an iron tube of the thickness and strength of commercial gas pipe, we have manifestly a sufficient protection to the wire from trowels, hatchets, nails and the like, to injury from which articles the unprotected wire would be subject at installation. The rigid pipe at no point on its surface offers an opening to a pointed tool, the smooth rounding surface turning the force of the blow from any instrument which might be directed towards the conduit. In this particular it is claimed to be in striking contrast with the flexible iron conduit, which at each unit of its length is said to present a crack or opening which will engage any point striking it, allowing danger to creep near the wire.

As to offering fireproof protection from any wire which may become heated, this point needs no enlargement; the fact is quite evident. It is apparent that most perfect results must necessarily be had in practice with the use of this superior type of enameled conduit.

One of the essential features of a perfectly safe electrical conduit is a smooth interior. This required smoothness, the manufacturers claim, is found most perfectly in a rigid enameled tube, as in tubes of other descriptions smooth and continuous surface is sometimes sacrificed in obtaining flexible, insulating and other unnecessary qualities. Slight observation will show to what extent a strip of steel or other metal wound in the form of a tube will cause an uneven interior surface; and to a slight extent the same fault is experienced in tubes which are lined with spirally wound paper, sheet rubber or other materials. A tube in the form of a gas pipe perfectly cleaned from burrs, scale and other imperfections (incident to pipe in the crude shape), the cleaned surface then being specially treated and prepared and finally enameled, as in the manufacture of "Loricated" electrical conduit, furnishes not only a safe installation for carrying electrical conductors, but also gives—what may not be of prime necessity, but is an item of importance in figuring cost—ease in construction and facility in drawing in the wire. In a tube of such description there is no buckling, no drawing away from the wall or straightening at the bends during installation, no splintering or loosening of a lining, no openings allowing entrance of moisture or particles of cement and like deteriorating agents to destroy the insullation of the wire, no projecting burrs or slivers of iron to tear the insullation, in short, no undesirable features; and after the wire is run safety is assured.

Messrs. Munderloh & Co., 61 St. Sulpice St., Montreal, Que., one of the leading electrical supply houses in Canada, advise us that electrical conduit has been a matter of serious consideration with them, and that they have found the trade call principally for the enameled type of conduit, the "Loricated" conduit, a product of the Safety-Armorite Conduit Company, Rankin Station, Penna., being generally used in high class installations. As a consequence, this is the only conduit they choose to handle. They have made such arrangements with the manufacturers that their stock is kept constantly replenished. They state that they hold the conduit trade of Canada (which is constantly growing to large proportions), and that they can lay electrical conduit down in any part of the country at most liberal terms.

## ABOUT CONDENSERS.

IN arranging for jet condensation with engines of ordinary dimensions, it is necessary to use considerable caution, says the American Machinist, as by reason of the short time required to overflow there is danger of water backing up into the cylinder at stopping, or slowing down, and in such a case a breakdown is likely to occur on again starting ahead.

It is not always convenient to arrange the injection valve within such range of the throttle that it can be at once closed on slacking the speed, and even where it is so placed it is much more satisfactory to provide against flooding in a way that allows the valve to remain at normal opening, as the injection requires some attention to properly readjust after being once changed.

The best all-round method of accomplishing the desired result is to place a float in the condenser, an air cock being operated by the lever when water rises above a safety point. This arrangement relieves the engineer of all anxiety, his only responsibility being to see that the apparatus is maintained in proper repair and working condition.

If a float cannot be used, a simple air cock, worked from near the engine throttle, will be found the next best device, as by a turn of the hand wheel at slowing down air enters the condenser and holds the condensation water back without necessitating the closing of the injection valve.

The class of engine known as "high-pressure condensing," in which there is no vacuum under normal conditions—the exhaust steam being simply discharged into a tank of feed water for the purpose of heating the latter—should be supplied with a float and air cock, as on stopping the steam in cylinder on exhaust side of piston is liable to condense, and in that case, unless proper provision has been made to prevent it the feed water in tank will block up in the engine and possibly fracture the cylinder head when steam is again turned on.

The use of a float in either type of engine prevents flooding due to the pumps failing to function properly.

Air-pump valves are often found broken, if of metal, or torn, if of the soft rubber so often used, and in such cases the pump is likely to fail to clear the condenser.

Foreign substances, waste, chips, etc., are very often jammed in the passages, and where the valves open downward—hanging—held to their seats by springs, the stud nuts are liable to work loose, letting the valves fall into the chamber below. For this reason pumps should be designed with lifting valves only, in which type the springs can be much lighter, and the seating is far more satisfactory than where both the weight of valve and column of water must be balanced by the stiffness of a wire coil.

# ENGINEERING and MECHANICS

## EXAMINATION QUESTIONS.

W. H. Wakeman, in The Tradesman.

(Continued from April issue.)

49. How do you determine the capacity of a pump?

A. Multiply the area of the piston by the stroke (both in inches) and by the number of strokes per minute. Multiply the area of piston-rod by the length of stroke, and by one-half the number of strokes per minute. Subtract this from the above, and the remainder will be the capacity of the pump in cubic inches, assuming it to be an ordinary steam pump. Divide by 231, and the result will be the number of United States gallons discharged by the pump, provided there is no "slip"; but the amount of water actually delivered will be less than the above calculation calls for, on account of the "slip," which varies with the kind of pump and its condition.

50. When piping up a pump, which valve would you put next to the boiler on the discharge pipe, and why?

A.—The stop-valve should always be put nearest the boiler, in order that the engineer may shut off the pressure when necessary to examine or repair the check valve.

51. What is a British Thermal Unit?

A.—The amount of heat necessary to raise the temperature of one pound of water one degree Fah.

52. The stroke of an engine is 48 inches and the cut-off takes place at eight inches. What is the ratio of expansion?

A.—Six.

53. The initial pressure on a piston is 80 pounds, and the terminal pressure is 20 pounds, both absolute. What is the ratio of expansion?

A.—Four.

54. The initial pressure on the piston of an engine is 95 pounds and the terminal pressure 7 pounds, both by the gauge. What is the ratio of expansion and how is it calculated?

A.—This will depend upon the location, as the elevation above the sea will affect the result. In such cases it is customary to assume that the engine is at sea level, and to take the atmospheric pressure at 15 pounds per square inch, which must be added to both the pressures given, making them 110 and 22 respectively. Dividing the former by the latter shows that the ratio of expansion is five.

55. If the clearance is taken into account, how does it affect the result?

A.—It gives a lower rate, because the amount must be added to the stroke and also to the point of cut off. It is not taken into account when calculating the ratio by pressures.

56. Give five reasons for pounding in steam engines?

A.—Lost motion in the bearings, loose and worn piston rings, lack of compression, insufficient depth of counterbore, and a piston that is loose on the rod.

57. What is lap on a valve?

A.—The amount that it laps over its ports.

58. How many kinds of lap are there, and what are they?

A.—Two; inside and outside. The former means the amount towards the centre of valve, and the latter refers to the amount at the end of it.

59. What is meant by the lead of a valve?

A.—The amount that it is open when the engine is on a centre.

60. What is a port on a steam engine?

A.—A passage to admit steam to and exhaust it from a cylinder.

61. What are the larger on a Corliss engine, the steam or the exhaust ports?

A.—The exhaust ports are usually the larger, in order to allow the steam to escape without unnecessary back pressure.

62. Why are feed water heaters used?

A.—In order to save heat by heating the feed water with exhaust, or waste steam, and to prevent unequal contraction of boiler plates due to feeding cold water.

63. If you were obliged to feed cold water into a boiler, how would you have the feed pipe arranged?

A.—Such a practice should be condemned on every convenient occasion, but if it must be resorted to temporarily, the feed pipe should be continued into the body of water in the boiler, so as to avoid discharging it directly on to the plates.

64. Give four reasons for the failure of pumps to work?

A.—Failure of the water supply; leak in the suction pipe; valves that do not seat properly; and a piston that is worn so that the water slips by it.

65. Give two reasons for the failure of injectors to deliver water against pressure?

A.—If there is a leak in the suction pipe, air will enter and prevent the delivery of water, although it may not prevent the water from coming to the injector. If the water is so hot that it cannot condense the steam, the injector will not work against pressure.

66. Which is the heavier, a cubic foot of water at 40 degrees or a cubic foot of water at 210 degrees Fah.?

A.—The cubic foot of water at 40 degrees, because as heat is added raising the temperature above 40 degrees, the water expands and consequently becomes lighter.

67. A column of water is 60 feet high. How much pressure per square inch is on the base of it?

A.—The temperature will make some difference, but in all such examples it is customary to assume that it is about 60 degrees, in which case the pressure is found by multiplying the height by .434 and 60x.434 equals 26 pounds.

68. What is heat?

A.—Heat is a form of motion.

69. The fly wheel on an engine is 6 feet in diameter and revolves 210 times per minute. The main belt transmits power to a pulley on the jack shaft that is 4 feet in diameter. What is the speed of jack shaft.

A.—Three hundred and fifteen revolutions per minute. It is found by multiplying the speed of the fly wheel by its diameter and dividing by diameter of pulley on jack shaft.

70. The fly wheel on an engine is 18 feet in diameter and revolves 65 times per minute. What is the speed of the main belt?

A.—Three thousand six hundred and seventy-five feet. It is found by multiplying the diameter of wheel by 3.1416 and by the revolutions per minute. 18x3.1416x65 equals 3,675.

71. Does the cross head of an engine stop at each end of its stroke?

A.—Yes. It is impossible for the direction of motion to be changed so completely without first coming to a full stop.

72. How often would you blow down a boiler?

A.—That will depend on the quality of the feed water, the hours run per day and the rate of evaporation. In the case of a boiler worked to its full capacity, running from twelve to twenty-four hours per day and using a poor quality of water, it should be blown down once in four hours.

73. What is meant by the tensile strength of a boiler plate?

A.—It means the force required to tear asunder a bar of it that is one inch square.

## WHEN A DYNAMO FAILS TO EXCITE.

In the case of a self-exciting dynamo which refuses to build up, a number of tests have to be made in order to locate the "trouble," and it is often necessary to make these in a hurry, for which reason it is advisable to make them in the right order. A list of these tests is given in a recent issue of the London Electrical Engineer, and they are briefly as follows: Make sure that the brushes are on the right place on the commutator, and, of course, see that the brushes really touch. Then see that they are set properly, relatively to one another; that is, if there are several sets of brushes see that the distances apart are equal; should the armature have a double winding, the brushes must, of course, cover more than one commutator strip at a time and must, therefore, be of the proper thickness to do so. Then start the machine and run it at its proper speed; if this does not make it excite, then find whether the shunt winding is really connected with the brushes, and if it is, then try for ground leakage, which is especially important in the case of a shunt machine, for if the field is short circuited the dynamo will, of course, not excite at all. Then see if there is not a break in the field winding, a fault which is more likely to arise in shunt machines. In looking for possible ground connections it is, of course, desirable to disconnect the machine from the circuits, as one of the two faults may lie outside of the machine. If all this does not help, try changing the shunt connections at the brushes, for if they have been connected wrong it is evident that the machine cannot excite itself; also see to it that the field windings are so connected that they give the proper sequence of poles and are not both north or both south poles. If there are slight signs of a field it may help to connect the two halves of the shunt winding in parallel, if that is possible, as, for instance, if there are two coils to the magnet;

this would increase the current in the field; but this, of course, applies only to shunt and not to series wound machines, as in the latter the parallel connection would reduce the ampere turns. Also see to it that the shunt and series windings, if it is a compound machine, are not opposing each other, for in the latter case the machine might run with a few lights but would lose its field as the load is put on. If all this fails to locate the trouble, the armature must be examined; to find short circuited coils in the armature excite the machine separately from some other source and note which section becomes overheated. If this does not locate the trouble, then run the machine separately excited at the normal voltage and see if the armature has its normal output; if it has not and the machine is a new one, there is something wrong with the armature. If this also fails to locate the difficulty the case may be considered a fairly hopeless one, and an expert may be called in.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL BANQUET OF HAMILTON NO. 2.

The thirteenth annual banquet of Hamilton No. 2, C. A. S. E., was held at the Commercial Hotel, Hamilton, on Good Friday Eve, April 13th. Besides a large representation of local members, a number of visitors were present. The guests from Toronto included A. M. Wickens, Executive Secretary; Charles Moseley, ex-president Toronto No. 1; John Dixon, Toronto, No 18; John Bain, William Bourne, Joseph Hughes, and W. G. Blackgrove. The tables were tastefully decorated and an excellent menu was served. The chair was occupied by past president R. Mackie, while F. J. Sculthorpe acted as vice-chairman. The toasts were responded to as follows:

"Canada Our Home," Rev. J. H. Long; "Mayor and Corporation," Ald. Pettigrew, ex-Ald. Donald; "Manufacturers," Messrs. Lyman and Smith; "Educational Interests," J. S. Williams, C. R. Fessenden, W. Davidson, and R. W. Geddes, Boston, representative of the Scranton International School of Correspondence; "The Executive Head," Ald. Pettigrew, A. M. Wickens, Charles Moseley, John Dixon; "Sister Associations," John Dixon and a number of other visiting members from Toronto; "Our Host and Hostess," H. Maxey.

W. W. Barlow, Mr. Abbs, Dr. McLean and O. Penny contributed vocal selections, T. Arthur presiding at the piano.

The local committee who arranged for the banquet were: R. Mackie, chairman; T. Chubb, J. Ironside, W. R. Cornish, F. J. Sculthorpe, D. Hunter, T. Cook.

## TRADE NOTES.

The Montreal Street Railway Company has placed an order with the Royal Electric Company for five 30 h. p. railway motors and controllers.

The Robb Engineering Co., Amherst, N.S., are building two 300 horse power tandem compound engines for the Demarara Electric Company, Georgetown, British Guiana.

The Waverly Gold Mines Co., of Waverly, N.S., has placed an order with the Royal Electric Co., of Montreal, for three of their direct current multipolar generators to light the Shubenacadie and Waverly mines.

The Robb Engineering Co., Amherst, N.S., recently received an order by cable from their English representatives, Messrs. Dick, Kerr & Co., for two 250 horse power engines for the Grimsby & Cleethorpes Electric Tramways.

Railway Motor Engineering is a new course of instruction offered by the International Correspondence Schools, Scranton, Pa. The course was prepared and is being kept up to date by Eugene C. Parham, superintendent of the Nassau Division of the Brooklin Rapid Transit. It is intended for operators and those who wish to become operators of electrical machinery, and contains practical instruction on the operation and maintenance of electric cars and motors. As instruction is carried on by mail, it affords a means of acquiring valuable information without obliging students to lose time from work.

The Canadian Association of Stationary Engineers, through Mr. Carscallen, M.P.P., brought forward at the recent session of the Ontario Legislature a bill providing for the inspection of boilers and the licensing of stationary engineers. A special committee was appointed to report on the bill. This committee, while approving to some extent of the principle of the bill, decided to take no action, but recommended that steps be taken next year to have a strict inspection of boilers in factories.

# TELEGRAPH and TELEPHONE

## CHEAPENING TELEPHONY.

THE greatest difficulties to be overcome in the engineering of telephone systems are in connection with the intricate network of wires required. From the house of every new subscriber two wires have to be taken to the exchange, and every new wire considerably increases the risk of breakdowns and short circuits. English statistics show that the time of an averge conversation is only two and a half minutes, and that the average number of calls is only eight per day. Assuming, then, that the subscriber is at his instrument twenty minutes a day making calls, and twenty minutes a day answering them, it follows that his wires are only used for forty minutes out of the fifteen hours which is the general duration of the daily service. The average load on telephone wires is, therefore, only about 5 per cent. of their full carrying capacity. Hence if we could make one pair of wires serve for several subscribers we could greatly cheapen the cost of the service. In the Electrician Mr. West recently described a system of telephony he has elaborated, whereby one pair of wires can be made to several subscribers. It has been thoroughly tested by the German postal authorities, and Mr. West states that they intend introducing it shortly into the German public telephone service. In this system the subscribers in one group can only ring up the exchange one at a time, the mere act of taking the telephone off the hook cutting out the others. If there are five ordinary subscribers the wires will be in use during a quarter of the time the exchange is open, and hence there will be a good deal of waiting; but to make up for this they will have the benefit of a 50 or 60 per cent. reduction of rates. Even with only three subscribers in a group a reduction of 30 per cent. could be given. The West system seems to us an excellent method of cheapening the cost of the telephone to groups of subscribers (preferably in the same building) who only use it very occasionally, as well as doing something towards reducing the multiplication of wires.

## SHORT-CIRCUITS.

The Bell Telephone Company are this year extending their underground system in Winnipeg.

The Bell Telephone Company are about to commence work on the building of a long distance system in Manitoba. We understand that 7,000 poles, which will cover 200 miles of the line, are now ready. It is understood that direct connection will also be made with the United States.

Several important improvements have been made in the Bell Telephone Exchange at Ottawa. The bell-ringing system has given place to automatic signalling telephones, the interesting feature of which is that instead of ringing the bell as formally, the subscriber has only to put the phone to his ear. The act of removing it from the hook flashes a signal lamp at central and a prompt response is made. When the phone is replaced on the hook, another signal is given which notifies the central that the conversation is ended.

Mr. S. S. Dickinson, superintendent of the Commercial Cable Company at Canso, N.S., left early in April for the island of Fayal, in the Azores, via New York. His mission was to arrange for the reception of the company's German cable which will land there. When completed the cable will make a direct connection between New York and Germany. Six hundred miles of this cable had just been completed off the cost of Nova Scotia, and the object was to commence paying out the cable from the Island of Fayal until a connection was made with the portion completed off the Nova Scotia shore.

## SPARKS.

The council of Sarnia, Ont., has passed a resolution requesting the Sarnia Street Railway Co. to adopt electricity as a motive power.

The council of Burlington, Ont., is considering the advisability of putting in a municipal electric light plant or giving a franchise to a company.

The Sarnia Gas & Electric light Co. have placed a contract with the Goldie McColloch Co., of Galt, for a 200 h. p. engine for their lighting plant.

Mr. Ernest S. Harrison, electrical contractor, of Winnipeg, is installing a new dynamo for the Keewatin Lumber Co., and is also re-arranging their lightning system.

Several prominent business men are promoting a scheme to establish a large power plant to supply the street railway, water works and private and public lighting in Woodstock, Ont.

The town council of St. Mary's, Ont., has been discussing the question of taking over the electric lighting plant of Mr. L. H. Reesor, and of submitting a by-law to the ratepayers for the purpose.

The village council of Canington, Ont., decided at a recent meeting to engage an electrical engineer to value the electric light plant, which will probably be taken over by the corporation.

Surveys have been made to locate an electric railway from Greenwood into the gold mines of the Deadwood, Wellington and Summit camps, the power to be supplied from Cascade. The promoters are the Greenwood and Pheonix Tramway Co., and the cost is estimated at $100,000.

The dam across the Murray river, built by the Labrador Electric and Pulp Company, is about completed. By the end of June it is expected that the villages of Murray Bay and Pointe au Pic, Quebec, will be lighted by electricity.

The Railway Committee of the Ontario Legislature has thrown out the bill of the Port Stanley Electric Railway Co., by which power was sought to increase the capital of the company from $40,000 to $240,000 and to build a line to London.

The Hinton Electric Company have submitted to the city council of Victoria, B.C., a proposition to operate the city pumping station by electricity. The cost was given as $22,900, made up as follows: Engine and dynamo, $9,800; 100,000 gallon electrically driven pump, $7,600; necessary wire, line material, etc., $5,500.

## MOONLIGHT SCHEDULE FOR MAY.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | P.M. 7.30 | A.M. 4.00 | 83.0 |
| 2.... | " 7.30 | " 4.00 | 83.0 |
| 3.... | " 10.30 | " 4.00 | 53.0 |
| 4.... | " 11.00 | " 4.00 | 50.0 |
| 5.... | " 11.30 | " 3.50 | 42.0 |
| 7.... | A.M. 0.10 | " 3.50 | 34.0 |
| 8.... | " 0.30 | " 3.50 | 32.0 |
| 9.... | " 1.00 | " 3.50 | 25.0 |
| 10.... | " 1.20 | " 3.50 | 23.0 |
| 11.... | " 1.50 | " 3.50 | 20.0 |
| 12.... | No Light. | No Light. | ..... |
| 13.... | No Light. | No Light. | ..... |
| 14.... | No Light. | No Light. | ..... |
| 15.... | No Light. | No Light. | ..... |
| 16.... | P.M. 7.40 | P.M. 10.20 | 2.40 |
| 17.... | " 7.40 | " 11.10 | 3.30 |
| 18.... | " 7.40 | A.M. 0.00 | 4.20 |
| 19.... | " 7.40 | " 0.30 | 4.50 |
| 20.... | " 7.50 | " 1.10 | 5.20 |
| 21.... | " 7.50 | " 1.40 | 5.50 |
| 22.... | " 7.50 | " 2.10 | 6.20 |
| 23.... | " 7.50 | " 2.50 | 7.00 |
| 24.... | " 7.50 | " 3.30 | 7.40 |
| 25.... | " 7.50 | " 3.30 | 7.40 |
| 26.... | " 7.50 | " 3.30 | 7.40 |
| 27.... | " 8.00 | " 3.30 | 7.30 |
| 28.... | " 8.00 | " 3.30 | 7.30 |
| 29.... | " 8.00 | " 3.30 | 7.30 |
| 30.... | " 8.00 | " 3.30 | 7.30 |
| 31.... | " 9.00 | " 3.30 | 7.30 |
| | | Total.......... | 145.30 |

## THE FORTHCOMING CONVENTION.

THE fire which occurred in Ottawa recently will not, we understand, seriously affect the forthcoming convention of the Canadian Electrical Association, although it will increase the labors of the members of the local committee. This committee is working faithfully to make the convention an unprecedented success. The committee on papers has also been performing its duties energetically, and some excellent papers have been secured. Among them is one by Professor Owens, of McGill University, on "Utilizing the Available Central Station Capacity"; another by Mr. F. H. Leonard, of Montreal, on "Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps," and another by Mr. O. Higman, of Ottawa, on "Government Electric Standards." Papers are also expected bearing upon telephony and telegraphy, the operation of street railways, and other interesting subjects. The date of the convention is June 27th, 28th and 29th.

## THE OTTAWA FIRE.

THE electrical companies in Ottawa suffered heavy loss by the recent fire which commenced in Hull, and which destroyed the major portion of the city of Hull and nearly two thousand buildings in Ottawa. The fire totally destroyed the street railway power house and contents, but the new 1200 k. w. generator direct connected to six Stillwell-Bierce horizontal turbines, which was installed recently in a new power house, was saved owing to its being built largely underground. The Ottawa Electric Co. (the lighting company) being the result of the amalgamation of three former electric lighting companies, had six power houses, namely, one central distributing station and five sub-stations, one of which was a steam station, and another was devoted to arc light exclusively. Four of these sub-stations, including the arc light station, were totally destroyed, even the walls of the buildings being useless. The company was left with its central station and steam auxiliary. While the arc light station was burning negotiations were going on for machinery for temporary use. We understand that letters of sympathy were received from the principal electric lighting companies in Canada, and valuable services were rendered by the Royal Electric Light Co., of Montreal, and the Toronto Electric Light Co. The company is now engaged in setting up, in a building owned by Mr. J. R. Booth where some water wheels were available, a temporary sub-station which will enable it to carry on its ordinary service while a new plant is being installed. The company is now supplying nearly all its incandescent service and motor service. Three days after the fire 150 street lamps were going, and it is expected that by the 10th inst. all the street lights will be on.

The Street Railway Company did not stop running, although the service was limited to some extent for a few days. They are now running full blast.

It is the intention of the Ottawa Electric Co. to erect a new and strictly up to date plant.

## REMOVAL NOTICE.

After May 1st the Montreal office of this publication was removed to larger quarters in the Imperial Building, 107 St. James street. Customers will always find the office open during business hours, and visitors in Montreal are extended a cordial invitation to call at the office, where they will be given every possible assistance and furnished with requisites for answering correspondence. The telephone number is Main 2299.

## PERSONAL.

Mr. Melitz has been engaged as electrician by the corporation of Acton, Ont.

Mr. John E. Wilson has commenced his duties as inspector of gas and electric light at St. John, N.B.

The management of the Winnipeg Street Railway have appointed Mr. Albert Mitchell as superintendent of the system, in succession to Mr. H. J. Somerset, who has removed to Australia.

Mr. W. Y. Hayes, manager of Bell Telephone Company at Windsor, Ont., is receiving the congratulations of his friends upon his recent marriage. The bride was Miss Harris, of London.

Mr. C. H. Wright, son of Mr. A. A. Wright, of Renfrew, has joined the engineering staff of the Canadian General Electric Company. Mr. Wright has been employed for the last four years on the Montreal Belt Line Railway, and when leaving he was dined by his fellow employees and presented with a diamond scarf pin.

The Sydney Gas & Electric Co., Sydney, C.B., is installing a 150 k.w. "S.K.C." two-phase generator, purchased from the Royal Electric Co., of Montreal.

Mr. John Carew, Lindsay, Ont., has ordered from the Royal Electric Company a complete electric light plant to light his saw mill and lumber yards. The order included a 10 k.w. multipolar generator.

## PUBLICATIONS.

"Compound Engines" is the title of a booklet of fifty pages just issued by the Power Publishing Company, of New York. It consists of a series of lectures by R. F. Lowe, re-printed from the columns of Power.

The Fort Wayne Electric Corporation have issued a booklet showing the prices paid for electric lighting throughout the United States. The arrangement is tabular form, the population, number of lamps, candle power, schedule, price per lamp, and cost of fuel, whether steam or water power, being given.

The Gas Engine Publishing Company, of Cincinnati, Ohio, have sent us a copy of the Gas Engine Hand-Book, by E. W. Roberts, editor of The Gas Engine. From a perusal of the book we can safely say that it is a valuable work, containing no descriptive matter relating to any particular engines unless the engine is a type in itself, as is the case with the Diesel motor. The author has covered in the 220 pages almost the entire subject of the gas engine design, and many of the formulas given are claimed to have not previously appeared in any work. Fifty thousand copies ol the first edition were issued.

## SPARKS.

The fire and water committee of the Berlin city council has been empowered to advertise for tenders for street lighting.

Local capitalists at Selkirk, Man., have applied for a charter to construct an electric railway and telegraph line from Winnipeg to that place.

The Baltimore Railway and Coal Company is considering the question of developing the oil wells in the vicinity of Baltimore, Albert County, N. B.

The electric light plant at Cardinal, Ont., was almost completely destroyed by fire on April 18th. The fire broke out in the Edwardsburg starch works.

The Montreal Star have placed an order with the Royal Electric Company for three 30 h. p. motor Teaser equipments, to be direct connected to their new printing presses.

The town of Yarmouth, N.S., has just taken tenders on two compound condensing steam engines of 60 h.p., with two boilers and fittings, for operating the plant at the pumping station.

It is said that the business of the Still Motor Company in Toronto has been purchased by British capitalists.

The Royal Electric Company, of Montreal, is installing an electric light plant for the Moulthrop Lumber Company in their mills at Spanish River, Ontario.

The Nova Scotia Electric Light Co. has made a second survey of the source from which it is intended to derive electric power for the Annapolis Valley. The company is said to be making plans to commence work at once.

The Marine Telephone Company, Limited, of Letete, N.B., is seeking incorporation, to establish a telephone system between St. George, Letete, Fairhaven, and other places. J. F. Catherine and Judson Matthews, of Letete, are interested.

Mr. W. B. Chapman, who is interested in the Demarara Electric Co., Georgetown, British Guiana, has returned to Montreal after an absence of five months. Mr. Chapman states that the work upon the electric plant is progressing favorably.

At the last meeting of the council of St. Louis du Mile End, a suburb of Montreal, the Royal Electric Company was given the contract for street lighting for the next five years. Forty-two lamps will be used, and the price, we understand, is $115 per lamp.

The forty-first meeting of the American Society of Mechanical Engineers will be held in Cincinnati, Ohio, commencing on May 15th. Papers will be read on the following subjects: On the Value of a Horse Power; Hot Water Heating from a Central Station; Systems of Efficiency of Electrical Transmission in Factories and Mills; Multiple Cylinder Engines; The Automobile Waggon for Heavy Duty.

Last month the Ontario Power Co. signed a contract of agreement with the commissioners of the Queen Victoria Niagara Falls Park, and paid over the some ot $300,000 representing the renta for two years. The company received its franchise to develop power from the Niagara river. The Ontario Power Co. will compete with the power company at Niagara Falls, N.Y. It is said to be the intention to commence development work immediately, the inital development to be from 30,000 to 60,000 h. p. The prospect of transmitting it to Toronto and Hamilton is reported to have been considered. The estimated cost of the proposed work is $2,000,000.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. X. JUNE, 1900 No. 5.

## THE LINDSAY LIGHT, HEAT AND POWER COMPANY.

### Opening of Their Electrical Transmission Plant.

A representative of the ELECTRICAL NEWS journeyed to Lindsay on Thursday, May 31st, to witness the formal opening of the new power plant of the Lindsay, Light, Heat and Power Company. Almost every Canadian was enjoying a holiday, in recognition of the news of the surrender of Pretoria, and at two o'clock in the afternoon upwards of one hundred and fifty persons got on board the steamer Crandella, provided by the company, which carried them from Lindsay to Fenelon Falls, where the power plant is located. The sail up the picturesque Scugog river was most enjoyable. Music was furnished by an orchestra.

At Fenelon Falls about an hour was spent in inspecting the falls and power house. In the absence of the president, Mr. Wm. Needler, the machinery was set in motion by the vice-president, Mr. Thos. Sadler, and its operation explained by Mr. C. H. Mitchell, engineer in charge of the hydraulic work. On the return trip the party reached Lindsay about 8 p. m.

#### ORIGIN OF THE COMPANY.

Some years ago Mr. B. F. Reesor, then one of the members of the Newmarket Electric Light Company, recognizing that electricity was but in its infancy, decided to install an electric light plant in the town of Lindsay. This being accomplished, he was given the contract for street lighting. His success induced competition, and another company was formed and continued to exist for some years. Mr. Reesor was joined by Messrs. Wm. Needler and Thos. Sadler, two prominent business men of the town, and the outcome of this amalgamation of capital was the incorporation of the Light, Heat and Power Company, of Lindsay, Limited, with a capital of $125,000, and the purchase of the competing electric and gas plants. Mr. Wm. Needler is president of the company, Mr. Thos. Sadler vice-president, and Mr. B. F. Reesor managing-director and secretary. For some time the company had been giving some consideration to the question of transmitting power from Fenelon Falls, and a demand for increased power, together, perhaps, with rumors of competition from a new company, resulted in the decision of the directors to undertake the development of the water power at that place.

FIG. 1.—GENERAL VIEW OF FALLS AND POWER HOUSE.

Early in the spring of 1899, the company purchased the water power from the Smith estate, or, more correctly speaking, secured a franchise to utilize 1,100 horse power. As the townships of Ops and Fenelon had granted a pole-line franchise to another party, the Lindsay, Light, Heat and Power Company applied to and secured from the Grand Trunk Railway permission to use their right of way between Lindsay and Fenelon Falls. The work of development was commenced in July of last year.

#### HYDRAULIC DEVELOPMENT.

The hydraulic division of the power plant is quite simple and compact. The falls at Fenelon, situated on the Gull river, are about fifteen feet in height, and a

short distance above the Government maintains a wooden dam for the purposes of the Trent Valley canal system, two locks of which are at this point, thus forming a beautiful sheet of water called Balsam Lake. This dam and the falls provide a total nominal head of 24 feet. The water is drawn off the upper level through a head race on the west side of the dam, and is led to the

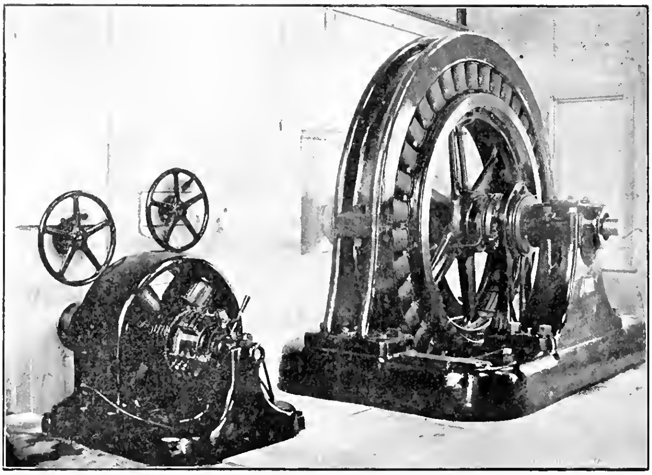


Fig. 2.—Generator and Exciter.

power house, which is situated immediately below the falls. The head race is substantially built in rock, the river side being formed by a heavy concrete retaining wall, the short side cut in rock, and the whole being about 150 feet in length. The head gates consist of a set of heavy stop logs with convenient raising devices, and the minimum section of race is 10 by 26 feet. Racks and seats for lower stop logs are provided at the piers and head wall in the north side of the power house, the steel flumes leading directly from the race at this point.

THE POWER HOUSE.

The power house occupies the site of the old Smith saw mill, in fact, it was built up inside of the mill the latter being torn down afterwards. The building is 37 x 52 feet inside, and all available space is occupied, as the location is cramped owing to the rocky bank of the river. A splendid view of the power house and falls is shown on the previous page. The power house is of plain but substantial construction, built of brick with stone foundation, and consists of two floors, the lower one containing the hydraulic machinery and generators, the upper having the lighter equipment, such as high potential switchboard, transformers, blower, stores, offices, etc., access to which is had directly from the bank level above the falls.

The head wall of the forebay, with its piers, forms the upper foundation wall of the building, and through this the three flumes lead the water to the wheels. Two of these are 11 feet in diameter and the third is 4 feet in diameter. The large flume next the river and the small one are already in use, the other large flume not being yet completed, but it will be used when future extension is made.

The hydraulic plant already in operation consists of a pair of 40-inch Samson turbines, of the Leffel type, for the generator, and a 20-inch turbine of the same make for the exciter. The turbines were manufactured by the William Hamilton Manufacturing Company, of Peterboro, Ont. The pair of power turbines are connected with the generator by a 7-inch horizontal shaft, and will generate together upwards of 650 horse power under a head of 24 feet, using about 300 cubic feet of water per second, and running at 200 r. p. m. The small wheel to run the exciter will develop about 60 h. p., only about half of which will be used by the exciter. The company are, therefore, using less than one-half of the water to which they are entitled by their franchise. At present the water wheel governor is not installed, but it is the intention to put in a high-class governor at an early date. The discharge of the water from the wheels is into a tail race cut into the rock below the falls, by which it enters the swift waters of the river, thus flowing rapidly away, a feature which is very important. Another promising feature of this plant is the absence of the formation of anchor ice, as the conditions for such cannot arise in the head race or in Balsam Lake above.

The intention of the company is to duplicate the present power plant as soon as the demand for power makes it advisable to do so. There is ample provision made for this in the power house and general works, and the water privileges of the company and consequent power obtainable are quite sufficient for a total output of some 1,000 h. p.

ELECTRICAL EQUIPMENT.

The generator building, as it stands at present, contains but one of the two direct connected generators

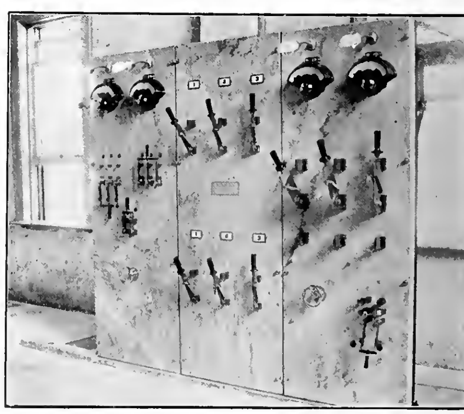


Fig. 3.—Generator Switchboard.

which it is proposed shall form the ultimate equipment of the plant. This machine is a 400 kilowatt, 550 volt, three-phase revolving armature generator of the Canadian General Electric Company's standard design, driven at 200 revolutions per minute by the wheels described above, to the shaft of which it is directly coupled without any insulating device. The field frame is cast

round laminated internally projecting fields, 36 in number, thus giving a frequency of 60 p. p. s.

The exciter consists of one 20 k. w., 125 volt, form "H" generator, running at 385 revolutions per minute, being directly connected to its wheel shaft similarly to the alternator. This method of connecting the exciter to a separate wheel is a comparatively new feature in engineering practice, possessing many valuable features

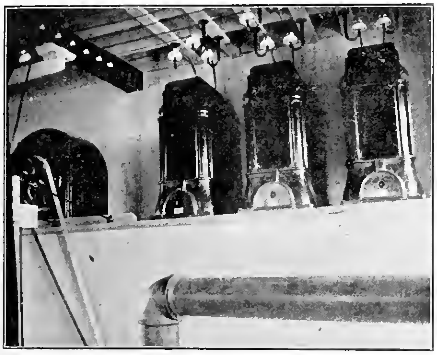


FIG. 4.—STEP-UP TRANSFORMERS IN POWER HOUSE.

over the usual method of belting from the generator shaft, and one the success of which will be watched with some interest. The exciter has capacity for exciting four machines similar to the one now in use, so that when the present equipment is doubled there will still be a large reserve of exciting power. A view of the generator and exciter is shown in Fig. 2.

The low tension switch-board, as shown in Fig. 3, is placed directly in front of the generators, so that the attendant has everything in plain view and within easy reach without having to move from the board. The board is of polished blue Vermont marble. Each panel, of which there are three at present installed, is in one piece, 80 inches high and 30 inches wide, this size enabling a very pleasing and symmetrical distribution of the apparatus contained. There is mounted on the boards the usual equipment of instruments and switches, the former of the Inclined Coil type, finished in black oxide, the latter being single-pole and quick-break for the heavier currents and of the ordinary double pole type for the smaller circuits. The three panels as installed control the generator, the exciter and the low tension side of the step-up transformers. When the capacity of the plant is increased three more panels will be added, one each with the additional machine and exciter, and one for the synchronizing instruments and paralleling switches which will then be necessary. The low tension transformer switches are arranged so that any one of the three transformers can be instantly cut out of service without in the least affecting the operation of the system; thus even should they be supplying a 24-hour service they can be regularly inspected and cleaned without danger to the attendant. Provision is also made on the board so that when the plant is increased either machine can be run separately on either set of transformers or all can be run in parallel.

All the low tension wiring is carried under-ground in conduits placed in the cement floor and covered by iron checker plate, this keeping all leads out of the way and free from liability to damage, at the same time giving facilities for inspection not excelled by overhead open work.

The three step-up transformers (Fig. 4) are rated at 135 k. w. each and give a pressure of 11,600 volts to the line. They are of the Canadian General Electric Company's standard air blast type, the primary and secondary windings being so arranged with ventilating blocks between that a very large radiating service is presented to the air blast provided by the blower, and thus the weight and floor space are both kept within very moderate limits; they run very cool under even heavy overloads, and the efficiency is high.

The blower is of the Buffalo Forge Co.'s standard low pressure type, 50 inches in diameter, and, like the exciter, is capable of delivering about four times its present output. It is driven by a two horse-power 500 volt induction motor, placed on the floor level. The blower stands on top of the air chamber similarly to the transformers, the discharge being down into the air chamber, which is of ample dimensions to allow the transformers being inspected and cleaned without difficulty.

The high tension panels, two in number, are placed close to the transformers, in order to keep down the amount of high tension wiring necessary. One contains six s. p. snap break switches, separated by marble barriers and controlling the transformer primaries, being connected so that any transformer can be cut off the line instantly if necessary. The other panel contains ground detectors of the astatic type, which are permanently connected to the line, and thus give a continuous indication of the state of its insulation. The high potential board is shown in Fig. 5.

The lines from the high tension panel ascend vertically to a wire cupola placed in the centre of the roof, going through its walls in heavy porcelain tubes to a cross arm bolted to the wall, and from there directly to the first pole. The eaves of the cupola are extended so as to

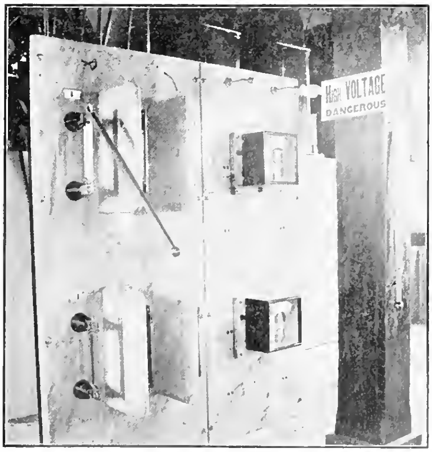



FIG. 5.—HIGH POTENTIAL SWITCHBOARD IN POWER HOUSE.

thoroughly protect the lines from any wet or dirt and the point where they pass through its walls. This cupola also contains the lightning arresters, of the Wirt type, one for each line, each consisting of a number of 2,000 volt arresters connected in series.

### THE POLE LINE.

The transmission line, fourteen miles in length, runs from the power house for about three-quarters of a mile

over private right of way until it strikes the Grand Trunk track running from Haliburton to Lindsay, which it then follows to within half a mile of the Lindsay town limits, there leaving the track and running directly south on Main street to the sub-station. It consists of three No. 4 B. & S. copper wires, bare, except for the small part inside the corporation limits, which latter is weatherproof. The wire was supplied by

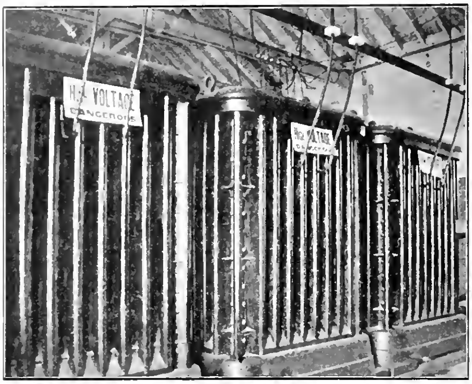



FIG. 6.—STEP-DOWN TRANSFORMERS IN SUB-STATION.

the Dominion Wire Company, of Montreal. The line is supported throughout by No. 1 Imperial porcelain insulators, triple-petticoated and tested to 20,000 volts. The pins are locust, the cross-arms being of 4x5 tamarack and double braced. The three wires are at present supported on one arm, though when the second line is strung they will be arranged so as to provide against any chance of voltage disturbance from mutual inductance of the two circuits ; it was not considered necessary to transpose the three wires now in use.

Below the transmission line is a telephone line, run on a standard two-pin arm, with the usual glass insulators placed three feet below the main line and transposed every fifth pole. The wire is No. 12 I.W.G. galvanized iron. No difficulty whatever has been experienced from induction troubles, the service being perfect, independent of the load on the main line.

The poles are of cedar, set 56 to the mile, varying from 35 to 50 feet in height, so as to make the line as level as possible. For the greater part of the distance no difficulty was experienced in setting them, as the ground is clean, though a little blasting was necessary on account of rock found near the Falls, and when crossing swamp the poles are for some 4000 feet supported by piles, to which they are bolted, some special device of this character being rendered necessary by the water which at this point covers the ground for the greater part of the year.

In addition to the lightning protection provided in both stations, a barb wire line runs over the full length of the transmission, fastened securely to the top of each pole and grounded at every third. This, it is expected, will take the majority of the discharges occurring near the line.

THE SUB-STATION.

The Lindsay Light, Heat and Power Company, before the installation of the new plant, ran two steam driven stations, and one of these has been changed to accommodate the new apparatus and is used as a sub-station. It contains a high tension panel similar to that of the power house controlling the primaries of the three oil-cooled 135 k. w. step-down transformers, giving a secondary voltage, which is varied, according to the load, from 1,050 to 1,150 volts, at which pressure the current is distributed to the lights and motors throughout the town.

Like the power house, all the sub-station low tension wiring is run in conduits under the floor, which is cement. The low tension switchboard consists of four polished marble panels, one similar to that in the power house, controlling the 1,040 volt side of the transformers, one containing the ammeters, voltmeters and ground detectors, and the remaining two containing switches controlling the various circuits throughout the town, these being arranged so that three phase or single phase distribution can be made as desired.

Power is now being supplied for lighting and power purposes in the town of Lindsay, and it is said that the current is steadier and more satisfactory than when the steam plant was in use. The company at present have the contract for lighting the streets of the town. They are also supplying a number of commercial lights and a quantity of power for grain elevators, refrigerating machines, printing presses, and other service. Their present lighting business consists of 7,000 incandescent lights of 16 c. p. and 60 arc lights of 60 c. p. It is said that in proportion to its population, the town of Lindsay uses more electric current than any other town in Canada.

All the electrical apparatus was furnished and installed by the Canadian General Electric Company, the expert work being done by Mr. Davies, of Toronto, and Mr. Smallpiece, of Peterborough. Mr. C. H. Mitchell, C.E., of Niagara Falls, Ont., had entire charge of the power development, which reflects great credit upon him. The power house and pole line construction was carried out by the Lindsay, Light, Heat and Power Company, under the superintendence of Mr. B. F. Reesor, assisted by his son, Mr. Walter Reesor. The successful operation of the plant must be a source of gratification to all concerned.

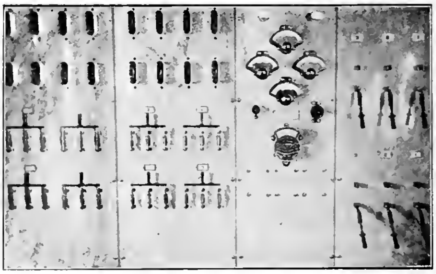


FIG. 7.—SWITCHBOARD IN SUB-STATION.

THE BANQUET.

In the evening a banquet was served by the Lindsay Company in a large hall in the town, which was prettily decorated for the occasion with flags and bunting. Probably 200 persons were present. The menu card was enclosed in a neat khaki cover and contained a list of

good things sufficient to satisfy the most exacting appetite.

The chair was occupied by Mr. J. D. Flavelle, president of the Lindsay Board of Trade, and the vice-chair by Mr. B. F. Reesor. Letters and telegrams of regret at their inability to attend were read from a number of distinguished personages, including Mr. Frederick Nichols, general manager of the Canadian General Electric Company, who was represented by his assistant, Mr. Geo. Watts. The toast list included: "The Queen"; "Our Manufacturing and Commercial Interests"; "Our Municipal Institutions"; "Electrical Enterprise"; "The Bench and the Professions," and "The Press," all of which were fittingly responded to. A noticeable feature of the speeches was the unanimity in commending the directors of the Lindsay Light, Heat and Power Company for their energy and business acumen in carrying to completion the enterprise which was responsible for the occasion. In responding to the toast of "Electrical Enterprise," Mr. C. H. Mitchell pointed out that the first stone of the undertaking had been turned within the last eight months, while at the

MR. B. F. REESOR.

great Niagara Falls the people had been waiting for the development of the power there for as many years. He said that all present might not be aware that the electric lights and fans in the hall were being supplied by current generated at Fenelon Falls. He believed that the development of water powers for the generation of electricity would result in the greater development of the mines near the town. He was certain that in the near future mining by electricity would be proven to be a practical success, as well as a laboratory success which it now is. After the disposal of the above toasts the company were asked to drink the health of the Lindsay Light, Heat and Power Company. This brought responses from Messrs. Sadler, Reesor and Stewart, and the evening closed with the singing of the National Anthem.

### MR. B. F. REESOR.

Mr. B. F. Reesor, managing director of the Lindsay Light, Heat and Power Company, a portrait of whom is here shown, first launched into the electrical business in the year 1886, when he installed an arc lighting plant in the town of Newmarket, Ont. At that time very few towns in Canada could boast of having their streets and places of business lighted by electricity. But Mr. Reesor was confident that electricity was the coming light. After successfully operating the Newmarket plant for a few years, he cast about for a larger field of operation, and finally decided to locate in the enterprising and promising town of Lindsay, where a favorable opening seemed to present itself. Notwithstanding that a gas plant of considerable dimensions was already in operation there, the reception given to the electric light was such that in a very short time his most sanguine expectations promised to be realized. The capacity of his electrical plant was speedily taxed to the utmost, necessitating the insallation of a duplicate plant. In less than two years after this increase his business expanded to such an extent that he was once more compelled to enlarge. About this time an opposition electric plant was installed in the town, and the two concerns were operated with considerable vigor and varying profits until July, 1895, when, as stated elsewhere, a joint stock company was formed and the opposition electric and gas plants absorbed by Mr. Reesor's company.

The completion of the long distance plant of the Lindsay Light, Heat and Power Company, one of the finest in Ontario, is but another indication of the progressive policy characteristic of Mr. Reesor. In him the company have a manager whose business ability, coupled with his extended experience in electrical matters, are sufficient to ensure the commercial success of the new plant.

## THE USE OF ACCUMULATORS.

MONTREAL, May 26, 1900.

Editor ELECTRICAL NEWS:

DEAR SIR,—In your April issue you make an editorial plea for accumulators. It is my purpose to point out a few reasons why they are not in more general use in Canada:

1st. Prime cost, the accumulator plant generally equalling in expense the engine, dynamo and wiring, after adding duty and freight. Considering the materials used in the construction of accumulators, there does not appear to be any valid reason why this should be, except we place it to patents acquired, litigation, and high running expenses of some of the manufacturing companies.

2nd. The number of alternating plants in use in Canada, accumulators furnishing as they do direct current, could not be used with transformers.

3rd. Accumulators, unless they receive (not ordinary but) skilled attention, are the most unmitigated nuisance known to the electrical fraternity, and unfortunately seven times out of ten they do not get that attention.

One other objection, which it is unnecessary to classify, may prove of interest. A certain large and wealthy public institution in Canada, any one of whose directorate could buy up, "lock, stock and barrel," a fair-sized electrical manufacturing business without emptying his pocket to any extent, received the following terms and a quotation on accumulators, which they were desirous of trying: "50% with order, 25% on shipment, balance three days after receipt of goods!" This was from the United States; needless to say it was refused. Moral—Buy in Canada.

Yours truly,

"ANTI-ACCUMULATOR."

The Chambly Water & Power Company will, it is said, materially increase their power plant at Chambly, and also develop another power of some 30,000 horse power. When the proposed improvements are completed, the company expect to have 30,000 horse power fully developed.

The United Electric Company, Limited, of Toronto, are working their factory day and night. One large contract which they have to complete in the near future is for Messrs. Lever Bros., Limited, for their Sunlight soap works now being constructed in Toronto. This contract comprises a 200 h. p. generator and some 15 specially designed cast steel iron-clad dust proof motors, to meet the requirements of the manufacture of their products.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
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*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**Canadian Electrical Association.**

IN consequence of the recent disastrous fire at Ottawa, where it had been arranged to hold the annual convention of the Canadian Electrical Association, it has been deemed advisable to postpone the meeting until September. A notification to this effect has been sent to the members. The place and exact date for the Convention have not as yet been fixed, but will be decided upon at an early date, when announcement of the same will be made.

**The Responsibilities of Telephone Companies.**

A PECULIAR action has been brought by George C. Stone and wife, of Onio, in the United States Court at Savanah against the Southern Bell Telephone Co. The plaintiffs owned a winter residence at Thomasville. At about two o'clock one morning they discovered that their home was on fire and undertook to call the fire department through the telephone, but could not get a response from the central office. Thinking it possible that their own telephone might be out of order, they went to their neighbors, but with the same result. Time was wasted in this way, and the fire obtained such headway that, when the fire department was finally communicated with through a messenger, it was impossible to put out the flames, whereas, had it arrived promptly, it is claimed the fire could have easily been extinguished before any material damage had been done. The plaintiffs state that they were subscribers to the telephone company, as was also the Thomasville fire department, and that it was the business of the company to furnish to each of its subscribers means of communication with all the others by means of the telephone at all hours of the day and night. Hence they claim damages from the company in the sum of $26,000, the value of their property. If claims of this nature are allowed by the courts the telephone companies will find it necessary to revise the terms of their agreements or go out of business.

**The National Electric Light Association.**

THE twenty-third annual convention of the above association held at Chicago on May 26th, 27th, and 28th, brought out a large attendance. Judging by the published reports, the proceedings were characterized by an earnest purpose to solve some of the more difficult problems which confront those connected with the management of electric lighting companies. Without neglecting the social features, which are a necessary part of the programme of such conventions, the more practical side of the meeting received perhaps closer attention than on some former occasions. It has come to be recognised that there are important objects to be attained by an association of this kind, and that its continued existence will depend upon the degree of earnest attention bestowed upon them. On the recommendation of the committee on standardization of electrical apparatus, the association endorsed the classification and rating of the various kinds of electrical apparatus, as defined by the American Institute of Electrical Engineers, whose recommendations are said to be already commonly recognized and followed by the manufacturers. Following the reading and discussion of a paper by James B. Cahoon, of Syracuse, N.Y., on "Uniform Accounting," a resolution was passed requesting the executive to appoint a committee to formulate a system of uniform accounting and report at the next annual meeting. Mr. Insull, a former president of the association, declared

himself to be strongly in favor of uniform and public accounts, that the people may see exactly what the profits of the electric-lighting business are in the case of each company. If municipal ownership must come, he said, let the business of the central-station company be bought out by the city at a fair valuation, determined by an equitable system of accounting. A committee was appointed to determine the best method of analyzing fuel gas. A recommendation to Congress to pass the bill now before that body to establish a national standardization bureau was adopted. Pending the establishment of such a bureau, the association is arranging to have standard 16 c.p. lamps of 110 and 220 volts prepared at Columbia University for the use of members. A committee is also preparing for publication a specification and drawings for a standard photometer room and its equipment, and has under consideration a standard form of simple photometer. The committee appointed to consider the subject of grounded circuits gave it as their opinion that while the permanent "grounding" of one side of the secondary circuit is not an absolute preventative of accidents to person and property, yet it is a step in the right direction, and, if adopted, will add greatly to the safety of the public, and reduce the hazards attending the transmission of electrical energy by what is known as the alternating or transformer system. Mr. James B. Cahoon, of Syracuse, N. Y., was elected president for the ensuing year, and we are pleased to note the election of Mr. Charles B. Hunt, of London, Ont., as a member of the Executive Committee. It is rumored that the next convention may be held in Buffalo in connection with the Pan American Exposition.

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**Trade Opportunities in the Oriental Market.**

Until very recently the eyes of Canada were turned almost exclusively towards the east, and her thoughts occupied with commercial matters in Europe. During the last few years it has occurred to many that the Pacific ocean, instead of being the back road from the country, might become a highway fully as important as the Atlantic, and this idea is certain not to be disappointed by results. Trade with Australia, China, Japan, Malaya and Polynesia is no mean prize to strive for, and the splendid Pacific highway at our doors places us in a position to compete favorably with any country. The rapid advances made by the United States and Japan in their Oriental trade shows that business methods adjusted to the established ideas of the east will bring a quick return, and that the lack of flexibility inherent in British trade methods is resulting in the loss of the previous overwhelming commercial supremacy. If Canada is to take that part in the Oriental market which should be expected owing to her favorable geographical position, it will have to be brought about by a careful study of the existing and prospective conditions and demands and by enterprise in pushing sales. Many discussions have taken place regarding the trade possibilities of China, and as many diverse opinions have been expressed, varying from the optimistic idea that the millions of China represent a market for our exports equivalent to a similar population in Europe, to the pessimistic opinion that these Chinese millions will eventually swamp our markets by their cheap productions. Both of these extreme opinions are based on the supposition that the country has been opened up to trade and that foreign investments have been rendered secure. The truth, as is generally the case, appears to lie between these extremes, for on the one hand no one who knows in any degree the conditions existing in the East will allow that its ability to absorb Western products is at all commensurate with its population, and that any deductions made from results in European countries are very misleading. On the other hand, Japan has progressed far enough to act as an object lesson in the increased cost of labor which results from an increase of production, and, speaking generally, it will be conceded that when a nation has arrived at some state of stability in her manufactures, the labor cost of the output will not be found to vary from the standard all over the world. For instance, labor in Europe is cheaper than in America when reckoned by the cost per hour, but it is found that in spite of this fact the labor cost of turning out manufactured articles is not very different owing to the greater rate of production per hour of the American artisan. This equalizing effect will be found to act as a corrective, and it does not appear at all probable that our western commerce is in danger of extinction at the hands of Oriental competition. The Oriental will be a keen competitor, but judging from his character he will not originate, but will be a very successful copyist. The initiative will be found without doubt in Europe and America.

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Apart from China and the French colonies in the East, trade there is less restricted than in Europe. In China the unwillingness of the ruling classes to admit the foreigner, the insecurity of capital, the fluctuating currency, and greater than all, the poverty of the millions, are the great obstacles in the way of the western trader. These are obstacles that cannot be appreciated at their full value without a knowledge of the Chinese character, of its inertness, its placid content with things as they are, its sense of superiority over the Barbarian. Under these existing conditions no opening of the trade door will take place from within, but the country will have to be burglarized by the Occidental nations, and this will probably not be long deferred. What form the forcible entry will take is not apparent, but it appears that as it requires an Asiatic to deal with an Asiatic, Japan and Russia are best fitted to obtain the advantage, and to hold it when obtained. If the open door policy prevail there will be large openings for railway enterprise. Many lines are already projected, but the question as to whether they would pay in many cases is exceedingly problematical, as China has a tremendous canal system, with cheap native labor as the motive power. However, many will be built, and this will require the services of many engineers and great quantities of materials. In the mining field the prospects are exceedingly good, the country having coal in many provinces and minerals in abundance. This, with cheap labor, will stand in the way of great importations of raw materials, and whatever staples are required will be manufactured in the country, so that given the open door policy, the first effect would be the importation of engineering materials and machinery, but it seems improbable that any great increase in staple imports could take place. This lesson may be learned from the history of Japan, where imports are decreasing and exports increasing—although the process in China will be very much slower.

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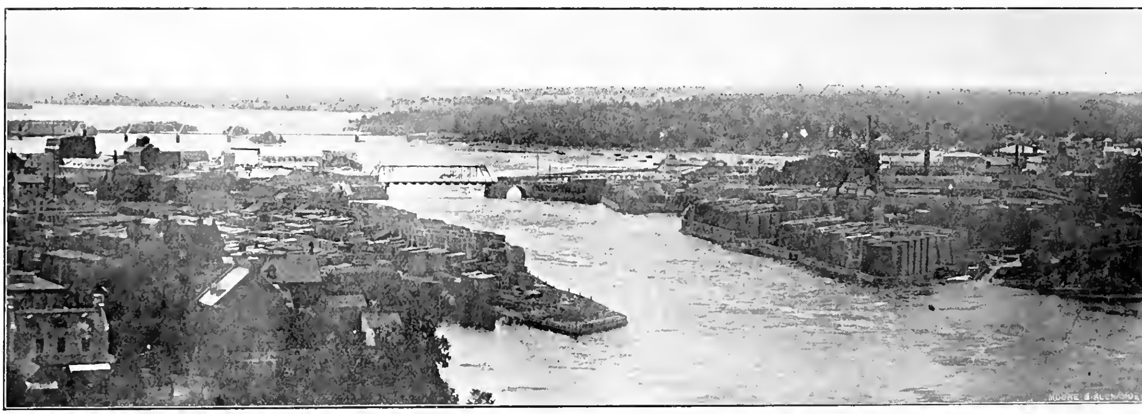
With the exception of the larger electrical machinery, Japan can and does manufacture for herself. China at

the present does not know that she requires any, and the other Eastern countries, while dimly conscious of the advantages of electric light and transportation, are apparently too inert to take the question up for themselves. It does appear, however, that live concerns going into the business as a specialty and covering the whole electrical field would be able to show good results, even at the present time, especially in small lines such as fans, bells, telephones, etc., the installation of ship plants, etc., with an occasional local plant, and perhaps an electric railway or two. The methods of selling electrical apparatus as at present carried on is very crude, large business houses handling the apparatus as they would hardware, without pushing sales, and being without the special knowledge which is required for this work, there are continual troubles with apparatus, and, generally speaking, there is no life in the trade. In many other lines the same methods prevail, and there is no effort made to thrust manufactures under the eyes of the customer and make trade. The Canadian Pacific Railway Company, in establishing the splendid steamship service to the East, has done much for Canada and Canadian trade, and it is owing to this fact that most of the Europeans and many of the Orientals have crossed Canada, and its products are known and could be largely extended in this field where enterprising management is seldom met with.



General View of the Chaudiere District, Showing Seat of the Recent Fire.

## THE HULL-OTTAWA FIRE.

Presented herewith are some views bearing upon the disastrous fire which occurred in Ottawa and Hull on April 26th last by which the electrical interests of that city suffered severely. The first illustration will give the reader a general idea of the magnitude of the fire and of the extent of the fire-swept district. Figure 2 is a view from Parliament hill of the fire while in progress, while the third illustration shows the ruins of the burned power house of the Ottawa Street Railway. The Street Railway Company had two power houses, the one recently built being a fire-proof construction and containing a 1,200 kilowatt generator direct connected to Stillwell-Bierce horizontal turbines. The roof of this building was not built on an absolutely fire-proof plan, being of corrugated iron laid over wooden rafters. The intense heat caused the roof to melt, the blazing mass falling upon the generator, but, it is said, without injury to it or any portion of the electrical plant. The old power house which was destroyed was operated by steam, and was to have been used as an auxiliary to the new power plant.

The Ottawa Electric Company suffered the loss of their four sub-stations, including the arc light station. They estimate their loss at $100,000. The work of rebuilding their plant is progressing rapidly, under the superintendence of Mr. A. A. Dion. Considering the great destruction, the customers of the company have suffered very little inconvenience, as new machines arrived the next day and were set up in a fire-proof building, owned by Mr. J. R. Booth, and once used as a saw mill. These machines are now being temporarily operated by two water wheels loaned for the purpose by Mr. Booth.

The destruction of a large portion of the plant of the Ottawa Electric Company has revived the agitation on behalf of certain members of the city council for the purchase and control of the plant by the municipality. Some months ago a special committee was appointed to report on the advisability of purchasing a municipal plant. The price at which the Ottawa company offered to dispose of their property to the city did not meet with the approval of this committee, who contend that in some respects the plant was not up-to-date. Now that the company are installing new and modern machines, it is thought that the present is an opportune time to renew the negotiations.

Another possible result of the fire is said to be the establishment of a large central power house at the Chaudiere. A scheme is announced to be on the tapis, the object of which is to secure the amalgamation of the manufacturing interests for the purpose of erecting a large power house to supply electric energy to the various industries in Ottawa and Hull adjacent to the Chaudiere. It is pointed out that the carbide establishments will require considerable power, and it is thought that it would be possible to induce a number of new industries to locate there.

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It has been announced that the Slave Lake Power Company, which purposes developing the water power at Slave Lake falls and transmitting electric power to Vancouver, B. C., have accepted the offer of the London Gold Fields Company to provide the necessary funds for the project. From this it appears that the proposition is likely to be carried to completion.

## BELTS AND PULLEYS.

The following questions are asked by a correspondent of Modern Machinery:

(1). How shall I determine the exact amount to cut out of a belt where a small pulley has been substituted for a larger one? (2) Is their gain or loss of power where two large pulleys are removed from shafts that run at the same speed, and a smaller one substituted, keeping the speed constant? (3) Which side of the belt should be put next to the pulley, and why?

The answers are as follows: (1) We advise you to use a tape line or a cord that will not stretch, and draw it over the pulleys, thus finding the exact length needed. If the new pulley is not much smaller than the old one, their respective circumferences may be calculated, and one-half of the difference taken, but if the diameter is very much less than before, the change in the angle of the two sides of the belt will affect the result. Therefore, the tape line method is the safest. (2) If you mean to ask whether more or less power can be transmitted, we should say less, for the belt speed is reduced and less surface is in contact with the pulleys, both of which are factors in the calculation. If you mean to ask which will require the most power to drive, there will be a slight difference in favor of using the smaller pulleys. (3) When a double belt is made, the hair or smooth sides are always put outward, so that it makes no difference which way the belt is put on, except on account of the rivets, and this shows plainly what the belt manufacturer thinks about it. If a single belt is examined it will be found that the rivet heads, which should run next to the pulley, are on the hair side, thus showing that the maker intended this side for the pulleys. The matter is in much dispute among machinists and mill men, and it probably always will be.

View From Parliament Hill of the Hull-Ottawa Fire While in Progress.

The Sydney Record states that the Sydney Gas & Electric Company have just put in a new 200 light dynamo and a 100 k.w. S.K.C. two-phase generator, a 250 h.p. tandem side-crank engine, and a 250 h.p. improved Mumford boiler.

The Electrical Construction Co., of London, Limited, have recently received orders for nine motors of various sizes from their agents in Montreal.

A by-law was carried on May 28th authorizing the council of Morrisburg, Ont., to acquire water privileges from the Dominion government and to construct electric light and power works. The vote stood 141 for and 16 against.

The Hull-Ottawa Fire—Ruins of the Street Railway Power House.

# MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, June 2nd, 1900.

THAT something is "in the wind" between the Royal Electric Company, Chambly Electric and Manufacturing Company, and the Montreal Street Railway Company, can be fairly taken for granted if there is any truth whatever in the many rumors around town. Some of these rumors have been denied in part, but only to crop up again in some other form and somehow refuse to be completely drowned. Names of prominent shareholders connected in the past with one concern are suddenly brought forward as acquiring stock now in one of the others. Some of the reports no doubt originate in the brains of our St. Francois Xavier street stock-brokers, who seem to delight in playing a sort of battle-dove and shuttle-cock game over Royal Electric and Montreal Street Railway stock, but if the latest report given on excellent authority be true, that the Chambly Company intend building a dam further up the river from their present one, then the statements of local members of the electrical fraternity bear the stamp of possibility, viz: It is stated that the Montreal Street Railway directors have been watching closely the development of both the Lachine and Chambly water powers with a view to utilizing at least a portion of one or the other company's output. They saw that the Lachine Company had considerable ice troubles their first winter, and also that the Chambly Company, who had this experience to profit by, did not entirely succeed in freeing themselves from ice troubles when they ran through their first winter. The Montreal Street Railway have also no doubt seen that the Lachine Company have run through their second winter without a hitch from ice trouble, and can see the precautions being taken by the Chambly Company to prevent any trouble whatever arising from this source again, as well as the projected works for increased power. Under the circumstances it is highly possible that they should wish to make use of this cheaper method of producing power, and have now sufficient confidence in the scheme to warrant their allying themselves, naturally to the company with whom they are most intimately connected, i.e., Chambly Electric and Manufacturing Company and Royal Electric Company. As to these two companies themselves, as one cannot live without the other, it would surprise no one if they amalgamated, in fact, it is almost a foregone conclusion. That the Montreal Street Railway, however, intend closing down their present steam power house in the near future is, as Kipling says, "another story."

ELECTRICAL SUPPLY HOUSES.

It is not so many years ago that the well-known firm of Munderloh & Company went into the electrical supply business. Formerly the firm handled glassware and a choice line of dry goods specialties. They also acted as agents for the Hansa line of steamships, and their late senior partner was the respected consul of the German Empire. This firm, however, noting the strides electricity was commencing to make, a few years ago decided to try and take a hand in the game—and with astonishing success. First, their action was a wise one, namely, to secure some person capable of handling this new branch of their business who fully understood it, and their happy choice fell on Mr. John A. Burns, who is a Montreal boy and a McGill graduate, having passed with honors and a degree of B.A. Sc. One of their first and best agencies is probably that of the General Electric Company, of Berlin ("Allgemeine Elektricitats Gesellschaft"), whose products, notably the A. E. G. well known incandescent lamp, they still continue to handle. Mr. Burns soon perceived that if he wished to avoid the formerly slurring expression "made in Germany," that he must educate his German manufacturers to produce the shape, style, etc., best suited to this market. It is a well known fact that the German workman can imitate almost anything, if given the opportunity and the price to do so. In this case the opportunity was given and the directions furnished to make a first-class high-priced (i.e., for Germany) article. The success of the scheme is evident, for although formerly the A. E. G. Company sold an enormous quantity of lamps in Europe, the shape, base, style, etc., did not take here, but after the "coaching" they received the result is that their American pattern lamp has a large sale, not only in Canada but in the neighboring republic. Mr. Burns has also succeeded in importing a two-wire porcelain cleat made according to specification, which surpasses in appearance any cleat produced in this market or in the United States. Messrs. Munderloh & Company also carry a full line of annunciators, electric light shades, cut-outs, batteries, switches, etc., from prominent United States centres, and have just lately started a manufacturing department for fixtures, brackets, and the like. The designs are mostly the work of Mr. Burns, who is a "worker," and spares neither trouble nor time to push forward his department. To use the words of one who knows a fixture—"their excellent finish and perfection in lacquering, combined with solid mechanical work, would put to shame some large Canadian houses who have been longer in the business and who make more pretence at fixture-making." It is understood a catalogue is in course of compilation. As Messss. Munderloh & Company stick to their own legitimate business and do no contract work, they have on their books a large number of contractors' names in Montreal and throughout Canada.

Many years ago, when incandescent lamps were more of a novelty than they are to-day, and when their "novel" price was kept up by those "in the ring," a gentleman of electrical aspirations, who will be nameless (as it will suffice to say that he never became friendly with any of the electrical fraternity, was more famed for his "avoirdupois" than for celerity, and has somehow been lost track of in the grand race for prominence in matters electrical,) got hold of an Austrian or Hungarian lamp agency. Seeing, evidently, that he could not "work" it alone, he sought for some one of more abiliy, and luckily happened to hit on John Forman, now of electrical supply fame in Montreal. Mr. Forman, with his natural shrewdness, it is said, declined the assistance (?), but offered good money for it to run alone, which history says was accepted. We here lose track of the electrical aspirant (sic) and turn to John Forman. So far as we are aware this was Mr. Forman's first venture in the electrical field. He was then, if memory serves aright, occupying chambers in the Chesterfield building on St. Alexis street. Seeing the possibilities before him, Mr. Forman took up other agencies, such as the Ediswan Company, and Crompton & Company, of London, Eng. He then opened with a well selected stock on Craig street, about number 650, moving some months later to the old stand of T. W. Ness at 644 Craig street. Here Mr. Forman, seeing the delays unavoidable with English agencies, turned his eyes to the United States also, and added many valuable lines to his already growing list. Just a few months ago Mr. Forman moved his business into the elegant building further west on Craig street, vis a vis to Alexander street, where he has a general electrical supply stock that would be hard to beat. Motors, push-buttons, switches, batteries, wire, bells, etc., are to be seen on the premises. When the Canadian Bryant Company wound up their business in Montreal, their stock, assembled and unassembled, was purchased by Mr. Forman, who continues to supply their well known types of cut-outs, sockets, rosettes, etc. Among Mr. Forman's latest acquisitions in the way of agencies may be mentioned those of the Gordon (formerly Gordon-Burnham) batteries, and the Lawrence Gas Fixture Company's electroliers, brackets, ceiling pieces, etc. For this latter agency he has, at considerable expense, fitted up a special show-room, handsomely and tastefully decorated. The colors of the decorations have been well chosen so as to make a telling effect on the fixtures, which in themselves are certainly choice and of late design. It is said that the total equipment of fixtures and brackets for the residential flats built by Mr. M. S. Foley on Dominion Square, have been furnished by Mr. Forman. From the foregoing it will be seen that any buyer will be well rewarded by paying Mr. Forman's establishment a call, and he will have to ask for something rather out of the ordinary if it cannot be shown him there.

Mr. R. E. T. Pringle, son of the well known hydraulic engineer, Mr. Thos. Pringle, and now possessor of one of the largest electrical supply houses in the Dominion, is well versed in electrical industries, having at one time occupied the post of superintendent in the factory of the Royal Electric Company. His establishment, which lately comprised two stores, one on St. James street and one on Craig street, has been now gathered together into the Craig street premises, which were much the larger of the two. This consolidation is appreciated by customers and gave Mr. Pringle an opportunity to put in, as he has done, a well selected and exceedingly varied stock—English goods, such as decorated push buttons, counterweights, etc., and American goods such as Patrick, Carter & Co.'s annunciators, Western Electric Co.'s lines, etc. In the Canadian goods, Mr. Pringle handles all the Packard specialties, such as transformers, lamps, and meters, and last but not least, the C. P. specialties. The trade mark

"C. P." is quoted by some as meaning "Canadian Produce," and by others as Cary & Pringle (Mr. Cary being the well known manager of the Packard Company.) Be this as it may, the trade in general owe them a debt of gratitude, for at the time this line of C. P. rosettes, sockets, cut-outs, switches, etc., were put on the market, we were just about in shape to be dictated to by a large United States combine, but C. P. spoiled the little game entirely. Mr. Pringle handles enormous quantities of wire, the weatherproof lines from a noted Canadian factory, and the rubber covered from a prominent United States concern. The popular sales manager for Mr. Pringle is Mr. Geo. Rough, who is well acquainted with the business, having taken a hand at it himself in the past when in St. Jo, Miss. Mr. Rough is a Montreal boy and eminently successful in making sales. Buyers calling at Mr. Pringle's will have to be hard to please if they cannot find what they are looking for, or if they have anything to cavil at in their treatment. We hear a good deal from supply houses across the line when they make a big sale; they are apt to print fac similes of cheques they receive for their goods, etc. It is a fact, however, that such items are of every-day occurrence with R. E. T. Pringle, and no fuss made over it either; in fact, were it not for this quiet manner in which their business is done, this item could be greatly extended, but their policy is not to blow trumpets.

NOTES.

We hear that Mr. George Hill, formerly employed by John Forman, electrical supply dealer, is now no longer with that firm.

Mr. John Shaw, of the Montreal Electric Company, who has been more or less of an invalid for six months past, is now able to put in a daily appearance at the office.

Mr. N. L. Piper, of Messrs. Noah L. Piper & Sons, Toronto, manufacturers of reflector shades, etc., is doing a good business with the electrical supply dealers in Montreal, and no representative is more esteemed. Mr. Piper is a man of few words; he sells his goods on their merits, and stands behind them.

The setting in of warmer weather seems to be having its effect in developing the usual spring crop of mushroom electrical contractors. There are many around already soliciting contracts who do not appear to know the difference between a cut-out and a socket. It is rather a pity that the winter is so severe in Montreal, so many "promising" saplings wither away before they have time to make a good sized tree.

Mr. Wm. Allan, the veteran engineer and dynamo tender at the Canadian Pacific Railway plant, Bisson street, has, we hear, resigned his position, to take a similar one with Messrs. Tooke Bros., St. Henri, whose electrical equipment has already been described in these columns. Mr. Allan has the good wishes of his electrical friends in his new sphere.

The promoters of the Shawinigan Falls plant speak of transmitting power to Montreal. As the distance is 80 miles, some electricians doubt if it will be a commercial or rather financial success, taking into consideration the high voltage required and our climate. Another phase may soon appear, and that is, that the supply of such power will exceed the demand. However, the enterprise deserves good wishes, and any electrical difficulties that may crop up will only be an incentive to their electricians to overcome, and the data on such will be sure to interest the electrical fraternity generally.

A couple of steam automobiles are in town, one belonging to Mr. Dandurand, of Queen's Park "bicycle track" fame, the other to the Cycle & Automobile Company, whose office is in Windsor Hotel block. As yet no manufacturer has tried conclusions with our hills with a storage battery electro-mobile, but it is rumored that an electro-mobile is under construction in the city.

There have been of late several accidents in this city, due to the electric current. A man named Zori Daw received an electric shock while working among wires at the corner of Notre Dame and Fulford streets, and was taken to the Notre Dame Hospital. R. F. Girdwood, employed by the Royal Electric Company, had a narrow escape from death. He was engaged in making a test of some apparatus when another workman, not knowing his position, turned on a current of 6000 volts. Besides receiving a severe shock, he was badly burned, and was removed to the hospital, where he is improving. It would seem that when any such testing is being done with the apparatus at a distance from the switch, it would be desirable to have a third party mid-way between, who would act as a check or safe-guard, in case of a misunderstanding of orders called from one employee to the other. The widow of George Peace is suing the city for $10,000 damages consequent upon the death of her husband, who was killed by an electric shock at the incinerator on St. Patrick street on November 10th last. Negligence on the part of the city is alleged.

## DOMES ON STEAM BOILERS.

By W. H. Wakeman.

A few days ago I fired up a boiler that had not been used for six months. After the air was forced out of it by the steam, through an open safety valve, the valve was closed and pressure allowed to accumulate. It was not tight, so I raised the lever and let steam blow freely through it. At first this steam was dry, but after about 30 seconds the discharge pipe was nearly half full of water that was coming out with the steam. As this boiler has no dome on it my attention was called by the incident to the difference between boilers that have domes and those that have none. In the above mentioned case the boiler was not flooded with water, as there was only two gauges, or no more than would be carried in practice.

The philosophy of the water coming out with the steam is as follows: When the safety valve was lifted enough to give the full capacity of pipe, there was a very great rush of steam through it, which lowered the pressure on the surface of the water immediately under the steam pipe. I do not mean to say that it was lowered very much, for it probably was not, but a difference of one pound is enough to cause trouble; for, as the pressure is maintained on the remainder of the water surface, it forces the water directly below the steam pipe out with the steam. Domes are put on boilers to obviate the evil, for they afford a very much larger opening for the escape of steam, consequently the velocity is less, and the water below the opening is not forced up with the steam. It is not assumed that the shell is cut away for the full size of the dome, as that would weaken the shell more than is necessary, but an opening that is twice the diameter of the steam pipe should be provided. Where there is a manhole in the dome, the shell is cut away enough to make an opening as large as the manhole. Those people who object to domes point out the fact that an opening of this size greatly reduces the strength of the boiler, but there is no good reason for this remaining so.

A boiler without a dome is usually fitted with a manhole in the shell, and this is reinforced with a frame that is supposed to be as strong as the metal in the shell was before it was removed. Suppose it was decided to put a dome on his boiler, and to locate it over the top manhole. Could any boiler maker consider it necesary to remove the frame as useless? I think not, for he would say that it supported the shell and made the whole structure stronger than it otherwise would be. This being true, why is it not good policy to put on a supporting frame inside of the dome when a boiler is built? If this was done the claim that a dome weakens the shell of a boiler would no longer be tenable; and this is the principal objection to having one included in the specifications. The claim that it acts as a reservoir for steam, to be used when wanted, as presented by those who favor it, is not worthy of serious consideration on account of its small capacity; neither is the objection offered to it by the opposition, who say that it acts as a condenser, as the surface exposed is not large, and it should be protected by sone good covering. The conclusion of the whole matter is, therefore, that a dome furnishes dry steam to the engine as above described, and it does not weaken the shell when properly constructed, any more than it does to put a manhole in shell at some other point.—The Wood-Worker.

# ENGINEERING and MECHANICS

## EXAMINATION OF ENGINEERS.

By W. H. Wakeman.

The examination of steam engineers for licenses on land or sea, or for admission into the various societies that are supported for the purpose of benefitting the craft, is always an interesting subject, and to prospective candidates for these honors it is peculiarly fascinating. As a rule an examining board does not adopt a list of questions for those to answer who apply for examination, although it may have such a list from which to make selections for use at various times. This makes it practically impossible to inform the candidate in advance of what he will be required to answer. He must therefore gain a general knowledge of the business, and having become well grounded in its fundamental principles, apply them to the solution of problems presented, use good judgment in formulating replies and never get nervous or excited.

All men are not qualified to pass these examinations, neither is every man who finds himself a member of an examining board qualified to discharge the duties of that important position.

Sometime ago it was the writer's privilege to attend an important meeting of engineers, a feature of which was an ideal examination of a candidate for admission to their ranks, and as much interest in the questions asked has been manifested, an article in which these questions are fully answered will prove benificial to many others interested.

There were twenty-five questions propounded, and while the replies given here are more elaborate than can be allowed for an ordinary examination, they are none too explicit to convey a full and correct knowledge of the subjects treated. The questions, answers, and explanations follow:

1. How would you proceed to inspect a boiler?

A. Every part of the shell, tubes and heads that can be reached should be examined and a thorough search made for places affected by internal or external corrosion, pitting, cracks, blisters, and bagging caused by lack of water.

Internal corrosion may be caused by steam and water leaking nto a not in use, or by certain impurities in the feed water while it is under pressure every day. External corrosion is caused by water dripping on the outside of it from leaky steam pipe, valve stem, or on account of holes in the boiler house roof.

Pitting is caused by impure feed water, and sometimes by allowing a boiler to stand many days with warm water in it, although said water may be pure. In some cases small blisters are raised on the metal, and when these are broken, pits, or hollow places are found under them.

Cracks are caused by unequal contraction and expansion, by injudicious use of the drift pin, and by expanding tubes into the heads. Very close examination will disclose their presence, and sheets and heads that are imperfect in this respect may be detected by means of a light steel hammer in the hands of an experienced engineer, as when they are struck the sound differs from that given out by sound iron or steel.

Blisters are caused by imperfections in iron plates, for where several pieces are rolled together to make a boiler plate the weld may not be perfect throughout the whole piece, and when put into hard service the different layers become separated and a blister is formed. If the defect does not not extend deep into the plate it may be trimmed, its extent carefully noted, and if the remaining portion is as strong as the riveted joint, no further precautions are necessary, except to make sure that it does not spread. If the blister is large and deep it will be necessary to cut it out and put on a patch.

The bagging of a sheet is caused by lack of water in direct contact with it. This does not necessarily mean that the water line has been allowed to fall so low that the part has been uncovered, for grease may have collected upon the sheet and thus effectually prevented the water from retaining it, the result of which is that it has been overheated and the pressure has bulged it out, or caused a "bag" to appear.

All of the rivets should be tested in order to detect loose ones, and every brace examined, for if one is loose or broken it will cause unnecessary stress to come upon others, which may strain or break them. While the engineer or inspector is inside the boiler, he should see that all the pipes connecting try cocks, water and steam gauges are free from rust and sediment, and if an excessive amount of scale is on the tubes and shell it should be removed. The safety valve should be examined and tested in order that it may be known to be in good working order, and all superfluous weights removed from its lever.

2. A boiler is sixty-six inches in diameter, the plates are three-eighths-inch thick, and have a tensile strength of 60,000 pounds per square inch of sectional area. The strength of the seams is 75 per cent. of the solid plate and the factor of safety is 5. What is the safe working pressure?

A. One hundred and two pounds. It is calculated as follows (for every applicant for a license should be able to explain the examples given him): The plates possess a tensile strength of 60,000 pounds per square inch of sectional area, but they are only three-eighths inch thick, therefore the ultimate strength of a strip one inch wide is $60,000 \times .375 = 22,500$ pounds. ($\frac{3}{8} = .375$.

A boiler plate cannot be considered stronger than its weakest part, and in this case the seam has 75 per cent. of the strength of solid plate, therefore $22,500 \times .75 = 16,875$ pounds, which is the actual strength of the plate put into this boiler, calculated from the weakest part, which is the seam. This is to be divided by one-half of the diameter, and $16,875 \div (66 \div 2) = 511$ pounds, which is the bursting pressure of this boiler. The factor of safety is 5, which means the bursting pressure is to be divided by 5 to obtain the safe working pressure. $511 \div 5 = 102$ pounds.

3. The area of a safety valve is ten square inches the steam pressure ninety pounds, and the distance from valve to fulcrum is three inches, and the ball weighs one hundred pounds. What should be length of the lever in order that the weight shall balance the steam pressure, neglecting the weight of valve and lever?

A. Twenty-seven inches. As the area of valve is ten square inches, the pressure ninety pounds, and the distance from valve to fulcrum three inches, these factors must be multiplied together and the product divided by weight of ball. $10 \times 90 \times 3 \div 100 = 27$.

4. Give the principal cause or causes for boiler explosions?

A. There is nothing mysterious about boiler explosions, as they are all caused by putting more pressure on than the boilers are able to carry, hence the failures. There is, however, a variety of reasons for this, as a boiler may have become weakened by abuse and unavoidable wear, until it is no longer strong enough to carry the ordinary working pressure. In many cases where boilers are not insured, the pressure to be carried is determined by what is needed to drive the engine, without regard to the strength of boiler. Some of the defects which weaken a boiler are so covered that it is impossible to detect them, and several explosions have occurred from this cause. Incorrect steam ganges and safety valves that require the use of a sledge hammer to lift them from their seats have caused explosions from over-pressure.

5. The crank of an engine is fifteen inches long and makes ninety revolutions per minute. How many feet does the piston travel in a minute?

A. Four hundred and fifty feet. As the crank is fifteen inches long, the stroke is 30 inches, so that the piston travels sixty inches per revolution, and $60 \times 90 \div 12 = 450$ feet. Some confusion seems to exist among men in charge of steam plants who are not well informed, concerning the proper way to measure the stroke of an engine, and some amusing results have been secured in efforts to calculate the piston speed under these conditions, but the above way is correct for making the calculation, and the way to determine the length of the crank is to measure from the centre of crank shaft to the centre of crank pin.

6. The initial pressure on a piston is seventy pounds and the compression is thirty-five pounds, both gauge pressures. Is the clearance half filled?

A. This is one of the questions intended to "catch" the candidate, or, in other words, to offer a test for quick action in arriving at conclusions, as the reply involves the consideration of several things. When the writer first heard that question it appeared as if the intention was to ask if the compression pressure equalled one-half of the initial pressure, when both are measured from a perfect vacuum, as this is the true basis from which to start. If we take the atmospheric pressure at fifteen pounds the total initial pressure is eighty-five pounds, and the compression fifty pounds, so that the latter is more than one-half the former. Such a reply might be understood as an attempt to put an incorrect construction upon sentences that are very plainly worded, and a candidate

is always justified in taking questions as they are given him. Viewing it in this light the reply would be, No.

The explanation of this is as follows: Under ordinary conditions we say that when a space is filled with steam, even if the pressure is only one pound above a vacuum, it is full, because nothing is there but steam, and yet when we bring the whole matter down to what is technically correct, a space is never full so long as it is possible to get anything more into it, therefore when steam is forced in until the pressure is thirty-five pounds by the gauge, it is not one-half full, neither is it full when the pressure rises to seventy pounds, for more can be forced into it, and it is difficult to locate the limit.

7. How do you find the ratio of expansion for a compound engine?

A. There are two ways of doing this, one of which is to determine the volume of the high pressure up to the point of cut off, also the total volume of the low pressure cylinder. Divide the latter by the former and the quotient is the ratio of expansion for the engine. The other is to multiply the ratio of expansion in the high pressure cylinder by the ratio in the low pressure, and the product will be the total ratio. There are many engineers in charge of fine plants that do not understand this, for it appears as if the ratios of the two cylinders should be added together instead of multiplied.

Take the case of an engine with a high pressure cylinder twenty inches and a low pressure forty inches in diameter, making the areas 1 to 4, and assuming that the cut off takes place at one-quarter stroke. This makes the ratio 4 for the high pressure cylinder, because at the end of the stroke the space filled by the steam is four times as large as at the point of cut off. When the exhaust valve opens and allows the steam to go to the low pressure cylinder, it fills it at an equal pressure up to one-quarter stroke, at which point the ratio is still 4, but when the low pressure piston has advanced to one-third stroke it is 8, at three-quarters stroke it is 12, and at the end of the stroke it is 16. As it is 4 for each cylinder, it is $4 \times 4 = 16$ for the combined or total ratio. In this case the effects of clearance are neglected, in order to make the illustration simple and comprehensive.

8. The areas of the pistons of a three cylinder triple expansion engine are 100, 300 and 900 square inches respectively. The ratio of expansion in the high pressure cylinder is 3. What is the ratio in the intermediate cylinder? What is it for the low pressure cylinder? What is the combined ratio?

A. As the ratio in the first cylinder is 3 and the second or intermediate cylinder is three times as large, the cut off would take place at one-third stroke, making the ratio 3. The low pressure cylinder is three times as large as the intermediate, therefore the ratio is three for this also, and the combined ratio is $3 \times 3 \times 3 = 27$.

Another way to explain this is to assume that the stroke of all pistons is thirty-six inches, thus locating the cut-off in the high pressure cylinder at $36 \div 3 = 12$ inches. The contents of it up to this point is $100 \times 12 = 1,200$ cubic inches. The contents of the low pressure cylinder is $900 \times 36 = 32,400$, and dividing one by the other shows that $32,400 \div 1,200 = 27$.

9. What is latent heat?

A. Heat that is not indicated by a thermometer. Heat is a form of motion, so that when water is heated to the boiling point the molecules of which it is composed are set in active motion. This is indicated by a thermometer, but when more heat is applied in order to increase the motion of the molecules and throw them further apart so as to form steam, it is not shown by a column of mercury, therefore it is said to be latent or hidden.

10. What is sensible heat?

A. Heat that is indicated by a thermometer, or that is sensible to the touch.

11. What is meant by the absolute zero of temperature?

A. It means a temperature so low that it is impossible for it to go lower. In other words, it means when the molecules are brought to a state of perfect rest. This has never been secured in practice, and is therefore a theoretical calculation only, but it is necessary for use in many engineering calculations. By the Fahrenheit scale it is 461, by Reaumer 229, and Centigrade 274 degrees below zero.

For the Fahrenheit scale, which is the one most commonly used in the United States, it is calculated as follows: It has been determined that a quantity of mercury will shrink about $\frac{1}{493}$ of its bulk for each degree that its temperature is lowered. Starting at the freezing point, which is 32 degrees, in order to reduce its bulk to nothing it must fall about 493 degrees, or to $493 - 32 = 461$ degrees below zero.

12. What is the total weight of a column of water whose cross-section is nine square inches, the height being one hundred feet and the temperature 62 degrees Fahrenheit?

A. 389.375 pounds. As the cross section of this column contains nine square inches and it is $100 \times 12 = 1,200$ inches high, it contains $9 \times 1,200 = 10,800$ cubic inches, or $10,800 \div 1,728 = 6.25$ cubic feet. At a temperature of 62 degrees, one cubic foot weighs 62.3 pounds, and the whole will weigh $6.25 \times 62.3 = 389.375$ pounds

13. What is the difference between a continuous and an alternating current of electricity?

A. A continuous or constant current flows in one direction only, but an alternating current (as its name indicates) changes its direction, or alternates many times per second, the number depending upon the design of the generator that supplies the current.

14. When the reading of the voltmeter and the ammeter are given, how do you determine the electrical horse-power?

A. Multiply one by the other and divide by 746.

15. What is a volt?

A. It is the unit of pressure in electrical work, the same as the pound is for steam pressure. When the conductor cuts 100,000,000 lines of force per second, a pressure or potential of one volt is generated.

16. What is a kilowatt?

A. One thousand watts, and as 746 watts make one horse-power, a kilowatt is practically one and one-third horse power.

17. Explain briefly the theory of mechanical refrigeration.

A. Some liquid or gas, usually ammonia, is compressed by a mechanical device called a compressor, or by expansion caused by the application of heat, until a high pressure is secured, and the heat concentrated, after which it is removed by cold water in a condenser. Passing on through pipes until an expansion valve is reached it is allowed to expand into a much larger volume in pipes of greater diameter. As it does not contain heat enough to supply the increased volume, it attracts it from the surrounding air, in the direct expansion system, from the brine in the indirect system, thus producing a low temperature.

18. Why is ammonia used in this process?

A. Because it is readily obtained at a moderate price, it is quickly changed from a gas to a liquid, and its expansive properties are very great.

19. What is the latent heat of ice?

A. It is 142 heat units. It is so called because when ice is at a temperature of 32 degrees it requires the application of 142 heat units to melt one pound of it into water at 32 degrees, and when in the form of water as above stated, it is necessary to abstract 142 heat units in order to freeze it.

20. Why is salt water used in circulating pipes instead of fresh water?

A. Because it can be reduced to a lower temperature without freezing.

21. What is a gas engine?

A. It is an engine in which either natural or manufactured gas is burned in the cylinder in order to move the piston.

22. What is a gasolene engine?

A. An engine in which the gas formed from gasolene is burned in the cylinder.

23. How do you determine the mean effective pressure of a gas engine?

A. A diagram is taken and its mean effective pressure computed the same as for a steam engine, but the time during which this pressure is acting on the piston must be taken into account. If there is one explosion for four strokes, the pressure shown by the diagram must be divided by four to decide the mean effective pressure for the full piston speed, or the actual mean effective pressure for one stroke may be taken, and one-fourth of the piston speed taken when calculating the power developed by the engine.

24. What is meant by a two cycle engine.

A. It means an engine in which there is one explosion of gas for each two strokes made. The term "two stroke cycle" is much more comprehensive.

25. Why are heavier fly wheels used on gas engines than for steam engines of the same power?

A. It is necessary to do this in order to maintain steady speed. In some engines there is one explosion for two revolutions of the machine, thus making the impulses far apart, so that in the absence of heavy fly wheels or balance wheels, to absorb and give out the power developed, the speed would be very unsatisfactory. The same is true, in a less degree, of two cycle engines.—The Tradesman.

## ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

The Ontario Association of Stationary Engineers held their annual convention in London on May 28th, at which there was present a good representation of the certificate holders. The report of the registrar as to the membership showed 917 as the total number upon the books, of which 13 have died, 8 are blank numbers, and 154 have been cancelled, leaving 742 members on the books.

The financial statement of the treasurer showed an income, including the balance from last year, of $653.99, and an expenditure of $517.89, leaving a balance on hand of $136.10.

A full discussion of the license law and the prospect of having it passed, brought out the fact that many steam users who were at one time opposed to the measure, were now favourable to it, and a committee was appointed to further enlighten the steam users generally as to the working of the proposed act.

The election to fill the place of the retiring members of the board, resulted in the selection of Messrs. O. P. St. John, of Toronto, A. E. Eakins, of Toronto, A. M. Wickens, of Toronto, and Alex. Findlay, of London. The board then elected its officers by selecting O. P. St. John as president; Thos. Elliott, of Hamilton, as vice-president; J. G. Bain, 113 Yorkville avenue, Toronto, registrar, and A. M. Wickens, of Toronto, treasurer.

A lively election occurred for the next place of meeting, St. Thomas, Paris, Brantford and Berlin all being named, with the result that the ballot was in favor of Berlin. The usual complimentary votes to the officers were then passed, and the meeting closed in time for most of the delegates to catch the evening trains for their respective homes.

## ELECTRICALLY OPERATED CONDENSER.

There was lately installed at the United States Government yard, Bremerton, Washington, an electric plant, one of the units of the plant being a special Smith-Vaile direct connected electrically operated jet condenser, as illustrated by half-tone engraving herewith. A sub-base is provided extending under the air cylinder, as well as condensing chamber, and also extended to receive a G. E. motor. The power end is provided with double reduction of gears ; the motor is provided with raw-hide pinion, and there is also a raw-hide pinion on pinion shaft of condenser. The gears are machine cut ; air cylinders removable and brass lined ; air piston is of bronze, fibrous packed and provided with expansion ring ; special priming valve is also furnished ; and the condensing chamber is provided with special distributing valve.

The condenser was manufactured and installed by the Stillwell-Bierce & Smith-Vaile Co., of Dayton, Ohio.

## HINTS ON LONG DISTANCE TRANSMISSION.

By R. W. Van Norden.

In stringing the wire for the new circuit between the Auburn power house, recently erected, and Sacramento, the supply of large tripple-petticoat glass insulators gave out, and temporarily standand two-petticoat glass insulators with teats were used to support a mile of wire. These latter were closely watched, especially in wind and rain. While the former often cracked or split, and in some cases set poles on fire, the ordinary insulators showed no signs of weakness. Locust pins were used, and as an extra precaution every pin was boiled in paraffine until thoroughly soaked. So far as can be ascertained by careful observation there has been no cracking, splitting or leakage, and no arm or pin has been burned or charred. The line has been cut out and thrown in suddenly every day for nine months ; but while the water in a storm hangs from the teats and drips near the wire or upon the arms, no results detrimental to the proper working of the line have been observed. Several large glass insulators have passed through severe storms without accident, though badly cracked. It is theretore a natural conclusion that boiling the pins in paraffine is of extreme importance.

The possibllity of synchronizing the machine at Auburn with the Newcastle generators, the distance between the stations being some five and one-half miles, and the line of No. 4 copper wire, was seriously questioned by some authorities, who claimed that as the capacity of the line was small, the effect would be to cause a current lag or a change in the form of the electromotive force curve and make the machines pump or altogether fall out of synchronism. Not the slightest difficulty of this nature was experienced. In fact, when Station No. 2 comes in, the operator at Station No. 1 hardly knows the moment, there being only a slight movement of the ammeters.

At present all regulation (the system is hand regulated) is done at Station No. 1. Station No. 2 starts up with a specified load, and as the general load increases, at a telephone signal Station No. 2 augments its own load 100 horse power at a time, every hour or half hour, until the maximum is reached. The operation is then reversed until Station No. 2 is cut out entirely.

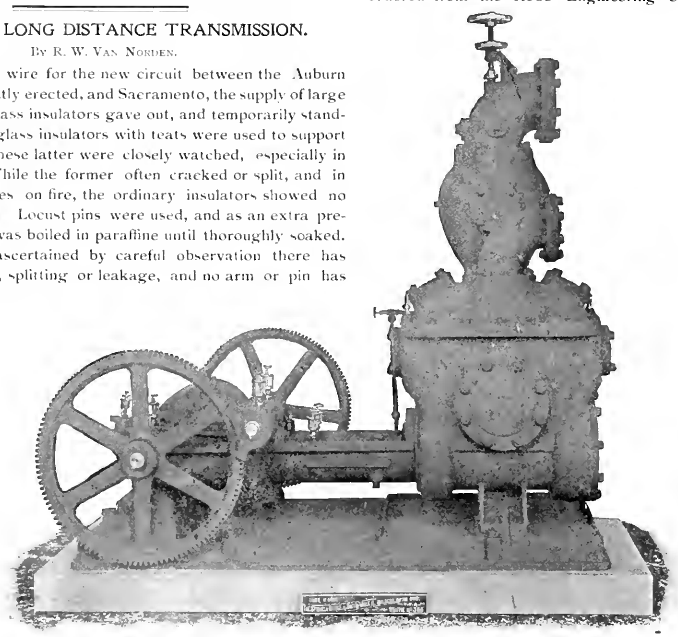
By this method no water is wasted at Station No. 1, where it is valuable for irrigation, etc., while at Station No. 2 the water must flow constantly, this station being on the same canal but farther up the country.

If for any reason the generator in Station No. 2 be underexcited, the difficulty can be remedied by over-exciting the lower generators. This causes a slight flattening of the electromotive force curve, however, so that a wattless current flows between the stations, which tends to make the voltmeters fluctuate very slowly but regularly about one volt, and the ammeters become unsteady.

The distance seems to have a cushioning effect, and it is not by any means so necessary to have the generators so near in synchronism when thrown together as when side by side.

It is therefore evident that stations may be distributed over considerable distance and yet run as one, all aiding to swell the total of current to be delivered.

*Paper read at the annual convention of the Pacific Coast Electric Transmission Association, San Francisco.



Smith-Vaile Direct Connected Jet Condenser.

## A COMPLIMENT TO CANADIAN ENGINEERING.

The Municipal Technical School, Manchester, England, has ordered from the Robb Engineering Co., of Amherst, Nova Scotia, a 150 h. p. tandem compound engine, to be directly coupled to dynamo from Dick, Kerr & Co., of London, for electric lighting. The order was given on the recommendation of Dr. J. T. Nicholson, Professor of Engineering, who was formerly at the Institute of Science, McGill University, and the purchasers state that this engine is to be placed with other engines of the leading British makers as an example of the best English and foreign practice in engineering.

The council of St. Mary's, Ont., have passed a by-law to provide $15,000 for the purpose of acquiring the electric light plant now owned by Mr. Reesor. The ratepayers will vote on the question on July 21st.

Mr. W. T. Steward, electrical engineer, Toronto, has removed from Temple Building to Room 38, Yonge Street Arcade. Mr. Steward has just given a valuation of the electric light plant at Galt, Ont., for the corporation.

In the report in last issue of the annual banquet of Hamilton No. 2, Canadian Association Stationary Engineers, it was stated that the response to the toast of "Education" was made by Mr. Geddes, of the Scranton School of Correspondence. This was an error, as Mr. Geddes represents the American School of Correspondence, of Boston.

## HANDY WIRING TABLES.

BY "W. K."

In many shops and mills where the readers of this journal pass twelve out of the twenty-four hours of each day, six days in the week, says the Stationary Engineer, they have to attend a dynamo for three or more hours per day at this season of the year. Should another lamp be wanted in some closet or over some bench, the engineer, of course, is the one to put it in. Oftentimes he may be in doubt as to the size of wire to run by which he would be insured of getting the full candle power. The tables accompanying this will show the current required by lamps of different candle power and voltages and the size of wire for a given distance in feet for any number of lamps of the two principal voltages now in use, viz: 50 volt alternating and 110 volt direct. The tables are correct and conform to the rules of the board of fire underwriters, and are the same as are used by one of the largest construction companies in Massachusetts. The tables are of such convenience in running wire that the task of selecting the proper size becomes an easy matter, and engineers having electric light work to do should preserve them for future reference. Table No. 1 shows the current in amperes required by lamps of different candle power and designed for different voltages. Table No. 2 shows the size of wire required for any number of 16 c.p. 110 volt lamps with the average loss of 2% at any distance from 50 to 200 feet. Table 3 gives similar information regarding 16 c. p. 50 volt lamps.

TABLE I.

Amperes per Lamp at Different Voltages.

| Voltage. | 50 | 60 | 70 | 75 | 100 | 110 | 120 |
|---|---|---|---|---|---|---|---|
| C. P. | Amperes. | | | | | | |
| 10 | .80 | .56 | .50 | .48 | .46 | .44 | .43 |
| 16 | 1.0 | .86 | .76 | .74 | .60 | .58 | .56 |
| 20 | 1.5 | 1.15 | 1.11 | 1.10 | .78 | .76 | .74 |
| 24 | 1.6 | 1.22 | 1.18 | 1.15 | .80 | .78 | .76 |
| 32 | 2.40 | 1.70 | 1.50 | 1.45 | 1.20 | 1.18 | 1.16 |
| 50 | 3.50 | 2.30 | 2.25 | 2.20 | 1.72 | 1.68 | 1.60 |
| 75 | 4.20 | 3.50 | 3.45 | 3.40 | 2.42 | 2.36 | 2.30 |
| 100 | 6.80 | 4.60 | 4.40 | 4.35 | 3.25 | 3.20 | 3.15 |

Watts per lamp = E.M.F. × current.
Ex.:—50 volts × 1 ampere = 50 watts.

TABLE II.

16 c. p. 110 volt lamps.
Current per 16 c.p. lamp, 110 volt = .56 ampere. No. 16 wire is the smallest allowed to be used by the underwriters.

| No. of lamps. | Distance in Feet. | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 60 | 70 | 80 | 90 | 100 | 120 | 140 | 160 | 180 | 200 |
| | Size of Wire, B & S Gauge, 2% loss. | | | | | | | | | | |
| 1 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| 2 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| 3 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| 4 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 15 |
| 5 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 13 | 13 | 13 | 12 |
| 6 | 16 | 16 | 16 | 15 | 15 | 15 | 14 | 13 | 13 | 12 | 12 |
| 7 | 16 | 16 | 16 | 14 | 14 | 14 | 13 | 13 | 12 | 11 | 11 |
| 8 | 16 | 16 | 15 | 14 | 14 | 13 | 13 | 12 | 11 | 11 | 10 |
| 9 | 16 | 15 | 14 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 10 |
| 10 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 11 | 10 | 10 | 9 |
| 12 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 |
| 14 | 14 | 13 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 8 | 8 |
| 16 | 13 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 8 | 8 | 7 |
| 18 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 8 | 8 | 7 | 7 |
| 20 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 7 | 7 | 6 |
| 25 | 11 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 |
| 30 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 |
| 35 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 |
| 40 | 9 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 3 |
| 45 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 3 |
| 50 | 9 | 8 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 |
| 60 | 8 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 2 |
| 70 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 3 | 2 | 1 | 1 |
| 80 | 6 | 6 | 5 | 4 | 4 | 3 | 3 | 2 | 1 | 1 | 0 |
| 90 | 6 | 5 | 4 | 4 | 3 | 3 | 2 | 2 | 1 | 0 | 0 |
| 100 | 5 | 5 | 4 | 3 | 3 | 2 | 2 | 1 | 0 | 0 | 0 |

TABLE III.

Sixteen c. p. 50 volt lamps. Loss 2% both sides of circuit.
Current per 16 c.p. 50 volt lamp = 1 ampere. No. 16 wire is the smallest allowed to be used by the underwriters.

| No. of lamps. | Distance in Feet. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 25 | 35 | 50 | 60 | 70 | 80 | 90 | 100 | 120 | 140 | 160 | 180 | 200 |
| | Size of Wire, B and S Gauge. | | | | | | | | | | | | |
| 1 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 16 | 15 | 15 | 14 | 14 |
| 2 | 16 | 16 | 16 | 16 | 15 | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 11 |
| 3 | 16 | 16 | 15 | 14 | 13 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 |
| 4 | 16 | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 |
| 5 | 16 | 14 | 13 | 12 | 11 | 11 | 10 | 10 | 9 | 8 | 8 | 7 | 7 |
| 6 | 15 | 13 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 7 | 7 | 6 | 6 |
| 7 | 14 | 13 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 |
| 8 | 14 | 12 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 |
| 9 | 13 | 12 | 10 | 9 | 9 | 8 | 8 | 7 | 6 | 6 | 5 | 5 | 4 |
| 10 | 13 | 11 | 10 | 9 | 8 | 8 | 7 | 7 | 6 | 5 | 5 | 4 | 4 |
| 12 | 12 | 10 | 9 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 3 |
| 14 | 11 | 10 | 8 | 7 | 7 | 6 | 6 | 5 | 4 | 4 | 3 | 3 | 2 |
| 16 | 11 | 9 | 8 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 2 |
| 18 | 10 | 9 | 7 | 6 | 6 | 5 | 5 | 4 | 3 | 3 | 2 | 2 | 1 |
| 20 | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 3 | 2 | 2 | 1 | 1 |
| 25 | 9 | 7 | 6 | 5 | 4 | 4 | 3 | 3 | 2 | 1 | 1 | 1 | 0 |
| 30 | 8 | 6 | 5 | 4 | 3 | 3 | 2 | 3 | 1 | 0 | 0 | 00 | 00 |
| 35 | 7 | 6 | 4 | 3 | 3 | 2 | 2 | 2 | 0 | 0 | 00 | 00 | 000 |
| 40 | 7 | 5 | 4 | 3 | 2 | 2 | 1 | 1 | 0 | 00 | 00 | 000 | 000 |
| 45 | 6 | 5 | 3 | 2 | 2 | 1 | 1 | 0 | 00 | 00 | 000 | 000 | 000 |
| 50 | 6 | 4 | 3 | 2 | 1 | 1 | 0 | 0 | 00 | 000 | 000 | 0000 | 0000 |
| 60 | 5 | 3 | 2 | 1 | 0 | 0 | 00 | 00 | 000 | 0000 | 0000 | 0000 | |
| 70 | 4 | 3 | 1 | 0 | 0 | 00 | 00 | 000 | 0000 | 0000 | 0000 | | |
| 80 | 4 | 2 | 1 | 0 | 00 | 00 | 000 | 000 | 0000 | 0000 | | | |
| 90 | 3 | 2 | 0 | 00 | 00 | 000 | 000 | 0000 | 0000 | | | | |
| 100 | 3 | 1 | 0 | 00 | 000 | 000 | 0000 | 0000 | | | | | |

## BY THE WAY.

By the courtesy of Mr. E. B. Merrill, I have been privileged to glance over a letter received by him from a friend, who is a Lieutenant with the volunteer detachment of Electrical Engineers (R. E.) in South Africa. This detachment, consisting of fifty men and four officers, was organized early in the year, and their offered services were eagerly accepted by the War Office, who granted £5,000 for equipment and apparatus. This consists of two search light trains, each comprising a steam traction engine, and two 24-inch projections, the latter mounted on gun carriages. Each train consists of twenty-three men commanded by a Captain. Each dynamo is mounted on a bracket in front of the engine and arranged for link belt drive. While the apparatus was being manufactured, the detachment were given a "send off" dinner at the Princes' restaurant in London, at which Lord Kelvin presided, and were also entertained by the Mayor and Corporation of Chelmsford. On March 16th they sailed for Cape Town. I quote from the letter the following further particulars: "Our plant is of our own design and something completely new in the field. The navy had already improvised lights by taking theirs off their decks and screwing them onto railway trucks, but their use was only for signalling, and they are tied to the railway line, whereas ours are perfectly as movable as field guns, and we are to take them right into the firing line, one idea being to cover the advance of men at night with a screen of light, and of course we would also be used in connection with heavy artillery for siege purposes. We have also got some very neat field telephone gear, and we have arranged bikes to carry reels of 22 bare copper wire, which can be paid out on the veldt at the rate of ten miles an hour if necessary. It is astonishing how little insulation is required. At some experimental runs we buried the two experimental wires in mud 10 feet apart at a road crossing, and the talking was quite distinct. We have also got a very complete equipment of tools, so that it would be a queer job that we could not tackle. We can work the lights up to a distance of one mile from the generator, the cables being arranged on drums mounted on gun wheels. As one instance of our usefulness, we could have enabled the artillery to reduce Cronje's defence in a couple of days, because he could not have had a chance to entrench at night time."

## BURLEIGH FALLS POWER DEVELOPMENT.

On Monday, June 4th, upon the invitation of Mr. J. A. Culverwell, managing director of the Central Ontario Power Company, a party of gentlemen from Lindsay and Peterborough made a visit of inspection to Burleigh Falls, where the plant of the company is to be located. On arriving at Burleigh Falls, per steamer from Lakefield, they crossed over to the mouth of Perry's Creek. The channel forms the overflow from the waters held back by the large dam above, and down its course an immense volume of water was racing. Fifty yards from where the creek empties into the lake the sides of the gorge come together within a few feet, and at this point the power dam will be placed. The solid granite sides of the gorge slope up from the narrow bottom in the form of a V, affording facilities for the strongest possible construction. It is proposed to build the dam of rock and concrete. The head of water is estimated at from 27 to 30 feet. The visitors were much impressed with the immense source of power, and the purposes of the company were explained to them, after which dinner was partaken of at the Burleigh Falls hotel, and some brief addresses given by Mr. Culverwell, Mr. McLaughlin, solicitor for the company, and others.

## PERSONAL.

Mr. J. W. Marr, chief engineer for the Metropolitan Railway Co., has resigned his position.

Ald. Robt. C. Pettigrew, president of the Canadian Association Stationery Engineers, was elected one of the board of managers of the Hamilton Art School at the annual meeting on May 28th.

Mr. Geo. McDonald, late electrician for the city of Moncton, N. B., has been engaged to superintend the installation of the electric power plant of the Truro Knitting Mills Co. at Truro, N. S.

Mr. Albert Mitchell, who succeeded Mr. Somerset as superintendent of the Winnipeg Street Railway, has resigned this position and has gone to Perth, West Australia, to engage in railway work.

Mr. J. Alex. Culverwell, electric and hydraulic broker, has removed from Toronto to Peterborough, having accepted the position of managing director of the Central Ontario Power Company, proprietors of the Burleigh Falls water power.

Mr. Frederick A. Hamilton, E. E., of Halifax, N. S., has been engaged by Clarke, Forde & Taylor, engineers to the Commercial Cable Company, to accompany the expedition which is to lay a cable from Canso, N. S., to New York. Mr. Hamilton expected to remain at New York to take the usual thirty days' tests.

Mr. S. Potter, superintendent of the London Street Railway, recently tendered his resignation, and we understand has been appointed chief engineer at the power house of the Toronto Railway Company. Before leaving London, Mr. Potter was made the recipient of a diamond ring and complimentary address form the employees of the mechanical department of the London Street Railway Company. Mr Potter has been succeeded by Mr. Harry Welburn.

We regret to record the death of Mr. F. E. P. Pepler, barrister, of Barrie. The late Mr. Pepler was among the enterprising citizens who in the early days assisted to introduce the electric light, having been one of the largest stockholders in the local company. Deceased manifested distinguished abilities, not only in his chosen profession, but also as a business man and in political and municipal affairs. He was twice elected mayor of the town and filled many other responsible positions.

The following gentlemen from Canada attended the recent annual convention of the National Electric Light Association at Chicago: Mr. Fred. Nichols, manager Canadian General Electric Co., Toronto, who is an ex-president of the N.E.L.A.; Mr. W. McLea Walbank, manager of the Lachine Rapids Hydraulic & Land Co., Montreal; Mr. C. B. Hunt, manager London Electric Co., London, Ont.; Mr. A. A. Dion, superintendent Ottawa Electric Co. and president of the Canadian Electrical Association; Mr. E. D. McCormack, Canadian General Electric Co., Toronto; Mr. R. S. Kelsch, superintendent Lachine Rapids Hydraulic & Land Co., Montreal.

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The Electrical Construction Co., of London, Limited, have recently received orders for four motors of different sizes from their Toronto agent.

The Noxon Company, of Ingersoll, have purchased from the Electrical Construction Co., of London, Limited, one 15 h. p. multipolar motor, and report being well pleased with the machine.

The Electrical Construction Co., of London, Limited, have completed a contract with the Chatham Navigation Co. for the wiring and complete installation of a 100 light electrical equipment for their boat at Chatham.

Mr. James F. Webb, of Ypsilanti, Mich., representing a syndicate of capitalists, is promoting an electric railway from Windsor to Ruthven and from Kingsville to Leamington, Ont. The capitalists are those who own the electric railway running from Ypsilanti to Orchard Lake, Mich.

## SPARKS.

A telephone line is being built from St. Martin's to St. John, N.B., the Bonny River Lumber Company being interested.

The Pontiac Telephone Co., of Pontiac, Que., was sold by the sheriff recently to Mr. William McCochon, for the sum of $1,700.

The St. Martin's Telephone Company, at annual meeting held at St. Martins, N.B., last month, elected John McLeod, M.P.P., president, W. H. Allan vice-president, and A. W. McMackin secretary.

Mr. E. H. Boss has resigned his position as local manager of the Bell Telephone Co. at St. Catharines, Ont., and has entered the employ of the Niagara, St. Catharines and Toronto Railway Company.

The Kinnear's Mills Telephone Co., of Kinnear's Mills, Que., are about to construct a telephone line from Thedford Mines to Kinnear's Mills, a distance of 12 miles, and have invited tenders for the work.

A recent report from Springhill, N.S., stated that owing to a disagreement between the town authorities and the electric light company as to the number of hours per night the light should burn, the contract had been cancelled and the town was in darkness.

The town of Dartmouth, N. S., made a proposition to the Dartmouth Electric Light Company to purchase their plant, at the price of $20,000. This the company refused to accept, and suggested $27,000 as the figure at which they would sell. It is probable that arbitration will be resorted to.

The electrical equipment of the D. S. Perrin Co., biscuit manufacturers of London, Ont., has gone through a great many radical changes since the company decided to operate their own plant. Originally a 125-light dynamo was thought to be sufficient for their requirements. This they found too small, but they retained it as a power generator to operate a 12 h.p. motor for running a box factory, and installed a 250 light dynamo to operate the lights throughout their factory. In the fall of 1899 they realized that they should have a larger lighting dynamo, but after receiving figures and making sundry tests they decided to retain the 250 light machine for another season, which they operated to over 250 lights regularly. They have now placed an order with the Electrical Construction Co., of London, Limited, for a 50 k.w. generator (67 h.p.), retaining the 250 light dynamo for operating their recently enlarged box factory. This makes four machines this enterprising firm of biscuit manufacturers have purchased from the Electrical Construction Co., of London, Limited, and they express themselves as well pleased with their operation.

The inauguration of the new electric street railway system at St. Johns, Newfoundland, took place on May 1st last. The road was built by Mr. R. G. Reid, of Montreal. The power house is situated at Petty Harbor, nine miles south of St. Johns. At this point a small river discharges its waters into the sea. The stream is fed from a chain of four lakes beyond the head of the valley, which run into each other. At the outlet of the last of these lakes Mr. Reid constructed a large dam, and from this a flume winds along a steep hillside for 3,300 feet, passing through a tunnel 350 feet in length, cut through the solid rock and terminating in a large sluice box of timber, at the bottom of which is a steel tube six feet in diameter, through which the water has a descent of 185 feet, to the bottom of the valley. The water wheel is 20 feet in diameter. The power house is 130 feet × 24 feet and is built of stone. The capacity of the plant is 3,200 h.p., although the present needs do not call for more than 2,350 horse power. The cars were built in Montreal. Mr. G. H. Massey, of Montreal, was superintending engineer, and Mr. W. Mackay electrical superintendent.

## SPARKS.

The Central Electric Company, of Portage la Prairie, Man., will enlarge their plant this year.

The council of Parry Sound, Ont., are considering the question of taking over the electric light plant.

The town of Palmerston, Ont., will probably purchase the electric light plant now owned by Mr. C. Anderson.

G. C. Hinton & Company have secured the contract for electrical supplies for the corporation of Victoria, B.C.

Conroy Bros. have commenced the erection of a new power house at Deschenes, Que., to replace the one recently burned.

It is announced that by the early fall the Metropolitan Electric Company, of Ottawa, will have completed their power plant at Britannia.

A scheme is said to be on foot to erect a large power house at the Chaudiere, Ottawa, for the purpose of supplying electric power for industrial purposes.

Grand Forks, B. C., ratepayers are to vote on a by-law to raise $50,000 to complete and extend the water and electric light system and to make other improvements.

A committee has reported to the Montreal city council recommending that tenders be invited for operating an incline railway service to the mountain, to be operated by steam or electricity.

The owners of the Dufferin Mine, on Salmon River, in Nova Scotia, have recently installed an underground electric lighting plant, said to be the first of the kind employed in that province. The engine is 250 h.p. Corliss.

The Jacques Cartier Water Company, of Quebec, have purchased property on the corner of St. John and d'Anteuil streets, in that city, and are having plans prepared for a brick and stone building to be built thereon, to be used as office and distributing station.

Among the companies incorporated at the recent session of the Nova Scotia Legislature were the following: The Liverpool & Milton Tramway Co., of Liverpool; the Liverpool Marine Railway Company, and the Cape Breton Electric Tramway & Power Company.

The Toronto Railway Company will ask the York county council for the right to extend the Mimico and Lake Shore road to the Lorne Park rifle butts. The company purposes asking Peel county for the right to extend to Oakville.

Mr. Willis Chipman, C.E., of Toronto, has reported for the corporation of Brockville, Ont., on the valuation of the gas and electric light plants in that city. He places the value of the gas works at $56,000, and that of the electric light plant at $38,000. The value of the arc system was placed at $8,000. The corporation will probably take over the plants.

Chicago capitalists, including Messrs. D. S. Wegg, J. P. Wiborg, G. K. Clutton, W. H. Dayton and G. H. Pope, have been incorporated as the Anglo-American Power Company, with a capital of $5,000,000. The company is to acquire the Jenison water powers on the Kaministiquia river near Port Arthur, which it is the intention to develop for power purposes.

## MOONLIGHT SCHEDULE FOR JUNE.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | P.M. 9.30 | A.M. 3.30 | 6.00 |
| 2.... | " 10.00 | " 3.30 | 5.30 |
| 3.... | " 10.30 | " 3.30 | 5.00 |
| 4.... | " 11.00 | " 3.30 | 4.30 |
| 5.... | " 11.30 | " 3.30 | 4.00 |
| 6.... | A.M. 0.00 | " 3.30 | 3.30 |
| 8.... | " 0.20 | " 3.30 | 3.10 |
| 9.... | " 0.50 | " 3.30 | 2.40 |
| 10.... | " 1.20 | " 3.30 | 2.10 |
| 11.... | No Light. | No Light. | .... |
| 12.... | No Light. | No Light. | .... |
| 13.... | No Light. | No Light. | .... |
| 14.... | No Light. | No Light. | .... |
| 15.... | P.M. 8.10 | P.M. 10.40 | 2.30 |
| 16.... | " 8.10 | " 11.10 | 3.00 |
| 17.... | " 8.10 | " 11.50 | 3.40 |
| 18.... | " 8.10 | A.M. 0.20 | 4.10 |
| 19.... | " 8.10 | " 0.50 | 4.40 |
| 20.... | " 8.10 | " 1.20 | 5.10 |
| 21.... | " 8.10 | " 2.00 | 5.50 |
| 22.... | " 8.10 | " 2.40 | 6.30 |
| 23.... | " 8.10 | " 3.30 | 7.20 |
| 24.... | " 8.10 | " 3.30 | 7.20 |
| 25.... | " 8.10 | " 3.30 | 7.20 |
| 26.... | " 8.10 | " 3.30 | 7.20 |
| 27.... | " 8.10 | " 3.30 | 7.20 |
| 28.... | " 8.10 | " 3.30 | 7.20 |
| 29.... | " 8.10 | " 3.30 | 7.20 |
| 30.... | " 8.30 | " 3.30 | 7.00 |
| | | Total......... | 130.20 |

## TRADE NOTES.

Messrs. Darling Bros., of Montreal, have placed on order with the Electrical Construction Co., of London, Limited, for two 5 h.p. bi-polar motors.

The Times Printing Co., of St. Thomas, Ont., have purchased from the Electrical Construction Co., of London, Limited, one 8 h.p. multipolar motor for operating printing presses.

The T. Eaton Co., Toronto, are making extensive changes in their electric plant, and have ordered two 350 horse power engines for direct connection to dynamos from the Robb Engineering Co.

The Electrical Construction Co., of London, Limited, recently received the following order from their agent in Winnipeg: One 1 h.p., two 2 h.p., one 5 h.p., and two 8 h.p. bi-polar motors, and two 15 h.p. multipolar motors.

The Electrical Construction Co., of London, Limited, report the following recent sales: Geo. May & Sons, Ottawa, one 5 h.p. motor; C. D. Burdick & Co., London, one 10 h.p. motor; The London Pant & Overall Co., one 6 h.p. motor; E. Parnell, London, one 8 h.p. motor; J. P. Archibald, Ingersoll, one 15 h.p. motor; Timbell & Co., London, one 3 h.p. motor; C. Kennedy, London, one 3 h.p. motor; H. W. Petrie, Toronto, one 12 h.p. motor; F. Raney, Kingston, one 8 h.p. motor; W. Carson, Kingston, one 3 h.p. motor; N. H. Good, Berlin, one 3 h.p. motor.

The United Electric Company, of Toronto, announce the following recent sales of apparatus: R. Anderson, Ottawa, one 30 h.p. motor, three 5 h.p. motors, two 12 h.p. motors, and one 2 h.p. motor; Chas. Morton, Montreal, three 2 h.p. motors; R. E. T. Pringle, Montreal, one 3 h.p. motor and one 8 h.p. motor; Miller Bros. & Toms, Montreal, four 5 h.p. motors, one 10 h.p. motor, and one direct connected elevator motor; John Turner & Son, Toronto, one 10 h.p. motor; Dominion Bridge Co., Montreal, one 60 k.w. generator; Maritime Electric Co., Halifax, N.S., one 10 k.w. direct connected generator; McBurney & Sons, Callander, Ont., one 20 light arc dynamo and lamps; Fred Thompson & Co., Montreal, one 5 h.p. motor and one 3 h.p. motor; S. F. McKinnon Co., Toronto, one 15 h.p. motor; Wm. McGill & Co., Toronto, one 10 h.p. motor; Canada Electric Co., Montreal, one 9 k.w. generator; West Lorne Electric Light Co., West Lorne, Ont., complete plant, both arc and incandescent, for lighting the town; Truth Publishing Co., Toronto, one 300 light dynamo; Darling Bros., Montreal, 5 elevator motors; Scott Bros., Ingersoll, Ont., one 10 h.p. motor; R. Elliott, Ingersoll, Ont., one 4 h.p. motor; P. Stewart & Co., Ingersoll, Ont., one 4 h.p. motor, C. S. Crabtree, Toronto, one 5 h.p. motor; A. Trudeau, Ottawa, one 5 h.p. motor; Paris Wincey Mills, Paris, Ont., one 500 light dynamo; C. N. Vroom, St. Stephen's, N.B., one 6 h.p. 500 volt motor; White Packing Co., Stratford, one 400 light dynamo and one 15 h.p. motor; A. Bauer & Co., Waterloo, Ont., one 35 light dynamo; P. W. Ellis & Co., Toronto, one 3 h.p. motor; C. W. Huffman, Winnipeg, one 6 h.p. motor; Perth Flax & Cordage Co., Stratford, one 100 light dynamo; Hodd Cullen Manufacturing Co., Stratford, one 50 light dynamo; Kootenay Railway & Navigation Co., Kaslo, B.C., one 10 k.w. direct connected generator; Rideau Lake & Navigation Co., Kingston, one 250 light generator; Lippert & Co., Berlin, Ont., one 100 light incandescent dynamo; John McGowan & Co., Alma, Ont., one 60 light dynamo; James Fenwick, Preston, Ont., one 70 light arc dynamo; Hamilton Steamboat Co., Hamilton, one 150 light dynamo.

## SPARKS.

Tenders closed on May 30th for lighting the streets of Berlin, Ont., with 80 arc lights.

The village council of East Toronto have decided to again ask for tenders for a system of electric lighting.

The Paris Electric Light Company, Limited, of Paris, Ont., has been incorporated, with a capital of $20,000.

Mr. J. Carew, of Lindsay, Ont., has recently installed an electric light plant for lighting his saw mill and yards.

The Whitby Park and Electric Railway Company has been incorporated, to develop a summer resort scheme near Whitby, Ont.

Permission has been granted to the Sun Oil Refining Company, of Hamilton, to increase their capital stock from $15,000 to $50,000.

The promoters of the electric railway between Woodstock and Ingersoll, Ont., expect to commence the construction of the road in about a fortnight.

Mr. Jobin, an employee of the Quebec Lighting and Railway Co., was seriously burned at the Montmorency power house by coming in contact with a live wire.

The Citizens' Electric Light Company, of Smith's Falls, Ont., are increasing their plant. They will build a stone addition to the power house and put in another engine.

The city of St. John, N.B., has invited tenders for lighting the streets of the city by electricity. Tenders close June 29th. Mr. Robert Wisely is the director of the Department of Public Safety.

The Montreal Cotton Company have applied to the corporation of Valleyfield, Que., for a bonus of $50,000 and exemption from taxation for twenty years, in return for which they agree to considerably enlarge their works and to supply the town with light and power.

## SPARKS.

It is understood that negotiations are in progress with a view to installing an electric light plant at Port Maitland, Ont.

The by-law authorizing a bonus of $21,000 to the Port Dover, Brantford and Berlin Electric Railway Co. was carried in Berlin, Ont. a few days ago.

The time for receiving tenders for lighting the streets of Toronto by electricity and gas and for the supply of electric energy has been extended to June 15th.

The town of Toronto Junction, Ont., will issue debentures to cover the cost of installing an electric light plant. An expert has estimated the probable cost of a plant at $13,000

The Manhattan General Construction Company, of Newark, N. J., had the most extensive of the many arc light exhibits at the recent N. E. L. A. convention at Chicago. In the basement of the hotel this company had placed a 50 k.w. two-phase 1000 volt 60 cycle alternator, which was driven by a direct current motor. This alternator supplied two circuits of series alternating lamps, one of 12 lamps in a parlor occupied by the company's exhibit,and another of 10 lamps on the hotel's regular arc light standards in the street. The former circuit also contained incandescent lamps and instruments to show the constancy of the current obtained by the regulator when the arcs were cut in or short circuited. To connect up these circuits required 2,000 feet of lead covered wire. In addition to the two regulators in use on these two lines, the company showed a number of its standard sizes of the latest type, ranging in capacity from 12 to 100 lamps. The lamps shown in operation were of the latest type, with shunt regulating coils and no series coils whatever. The shunt coil is concentric with the carbon holder, and a dash pot, also concentric, is provided to prevent the shunt coil from striking the arc too suddenly, the dash pot cylinder being cut away so that over the normal range of operation, once the arc is formed, there is no retardation or friction. The cut-out is electro mechanical, the regulating magnet, in case it drops the clutch to its lowest limit, closing a by-pass around the arc, but through a magnet which holds the contact closed. With the shunt form of regulator used in this lamp, the power factor is improved over that of the series lamp, and, if desirable, the candle power of the lamps may be changed by simply varying the current, the arcs in this case remaining of constant voltage and not shutting up as they do in the differential form.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. JULY, 1900 No. 7.

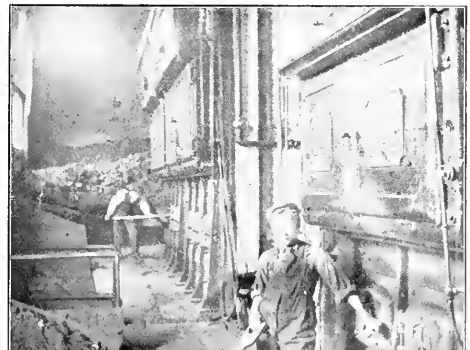
## THE IMPERIAL ELECTRIC LIGHT COMPANY.

The origin of the Imperial Electric Light Company, of Montreal, dates from the spring of the year 1892, when Mr. Israel Charbonneau installed a small dynamo in his saw mill. He afterwards accepted Mr. Jos. E.

IMPERIAL ELECTRIC LIGHT CO.—VIEW OF BUILDINGS.

Pare as a partner to assist him in promoting the business of electric lighting in St. Jean Baptist village, then a suburb of Montreal, but at present one of its most promising wards. Later these two gentlemen were joined by three others, Messrs. Jos. Girard, Damien Lalonde and Joseph Lalonde, and the business was extended towards the central part of the city. About the month of March, 1893, a company was organized to take over the assets and liabilities of the above mentioned co-partnership, and the St. Jean Baptiste Electric Company came into existence. On the first of June, 1896, the company was re-organized by the late Hon. Louis Tourville, and letters patent were granted on June 19th, 1896, incorporating "La Compagnie de Lumiere Electrique Imperiale," with a capital of $200,000. Messrs. J. M. Fortier, Arthur Caron, Hon. Louis Tourville, Onesime Marin, N. P., and Rodolphe Tourville were the provisional directors. Since that time some changes have occurred in the board from death and other causes, and the present directorate is comprised of Messrs. Victor Morin, N. P. president; Rodolphe Tourville, vice-president; E. J. Chapleau, treasurer; S. Z. Leboeuf and Dr. E.P. Chagnon, directors. The buildings as shown in Fig. 1, have a frontage of 184 feet and a depth of 94 feet, and are built of brick and stone. Previous to entering the works the attention of the visitor is directed to an inclined alley leading directly in front of the boilers, which is the means of dumping coal to the firemen, and which at the same time enables the company to keep an accurate record of the fuel used, by the employment of a Fairbank's scale. A portion of the space in this alley is occupied by a tank, 40 x 15 x 10 feet, of a capacity of nearly 30,000 gallons of water. This tank is kept well filled by means of an artesian well 235 feet deep. This well, the work of Mr. Wallace Bell, of Montreal, provides a very economical water supply. The Northey pump used in connection, has a capacity of 3000 gallons per hour, this supply of water being sufficient for steam and condensing purposes.

A chimney 134 feet high from the ground level, serves three Heine boilers, two of 250 h. p. and one 150 h. p., making a total capacity of 650 h. p. These boilers were built by the Geo. Brush Boiler Works, of Montreal. Two Worthington steam pumps are used to feed the boilers, and there is a heater also, to be used when running one of the high speed engines. In the engine room is found a Brown Cross Compound engine of 500 h.p., built with an attached direct-jet condenser. This engine was built by the Polson Iron Works Co., of Toronto, its fly wheel is $24\frac{1}{3}$ feet in diameter, and its speed is 68 revolutions per minute. The driving shaft operates 320 revolutions per minute, and is connected to the fly wheel by a belt 46 inches wide and 131 feet long, which cost $1,400. To the left of the large engine is seen two small engines, one 135 h. p. Leonard Ball Compound, and the other a 80 h. p. Leonard automatic, the pulley of which travels at 300 revolutions per min-

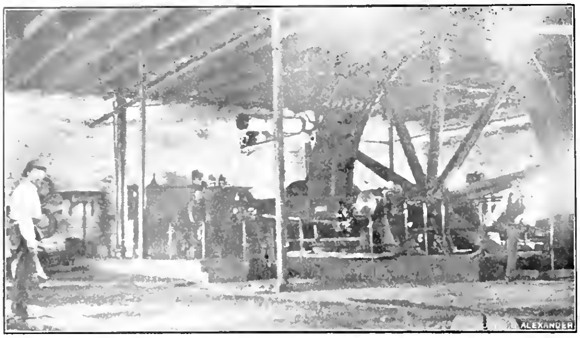


IMPERIAL ELECTRIC LIGHT CO.—BOILER ROOM.

ute. The main shaft, which was made by Messrs. Miller Bros. & Toms, of Montreal, is connected to the above mentioned three engines, and to three dynamos, and is easily controlled by Hill's friction clutches.

Two Westinghouse dynamos, 150 k. w., 2000 volts, ute, supply single phase current to a large number of 7200 alternations, operating at 730 revolutions per min-

customers. There are two Westinghouse exciters attached to the dynamos; these operate at 2150 revolutions per minute. There is also a third dynamo,



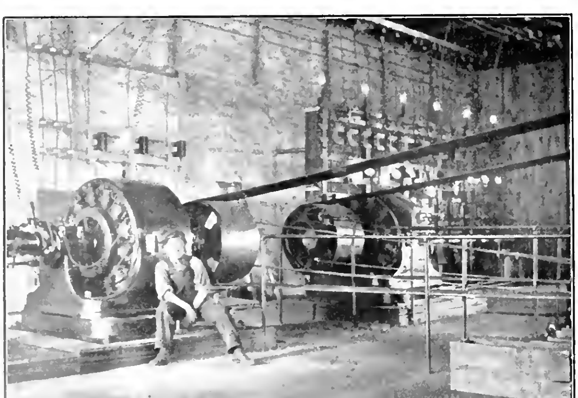
IMPERIAL ELECTRIC LIGHT CO.—500 H.P. BROWN CROSS COMPOUND ENGINE.

with exciter of General Electric Company's make. A squeleton switchboard (Figure 5), containing all the required instruments, including three I. R. regulators made by the Canadian General Electric Company, Peterborough, provides the means of distributing the current, which is by a system of five circuits. A battery of four high voltage transformers serves to reduce from 5000 to 2400 volts the current supplied this company by the Lachine Rapids Hydraulic and Land Company. This set of transformers represents a total capacity of 1000 h.p., three-quarters of which is at present used by the company.

There is an alarm gong, a complete tool and testing room, also the finest patrol service wagon in Montreal.

The Imperial Electric Light Company has entered into a contract with the Lachine Rapids Hydraulic and Land Company, by which it will be supplied with current by the latter company for the next eight years, and as means of precaution had their squeleton switchboard built to receive either Lachine Rapids water power current or steam power current. The business of the company is confined almost exclusively to stores, offices and places of business, the company having given no attention to the lighting of residences and public institutions.

The company is under the able management of Mr.



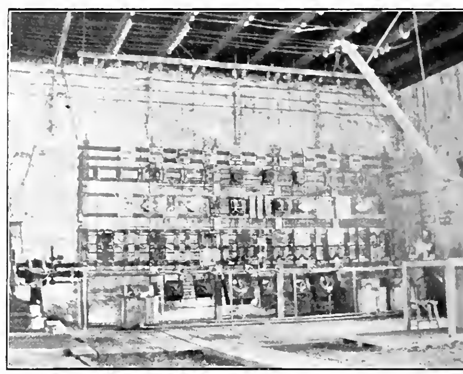
IMPERIAL ELECTRIC LIGHT CO.—WESTINGHOUSE DYNAMOS AND DISTRIBUTING SWITCHBOARD.

Jules Bourbonniere, a portrait and sketch of whom appeared in our last issue, and whose portrait is reproduced on following page. Mr. Bourbonniere holds the dual position of manager and secretary. He is a great student and possesses a remarkable fondness for literature. In his residence will be found an up-to-date library and a scrap-book room of the contents of which he may justly feel proud. In the management of his plant he has a reliable assistant in Mr. Alfred Lepage, superintendent, whose portrait appears herewith.

The company own several tenement houses adjacent to their works, these being occupied by employees.

## TREATMENT OF DRIVING BELTS.

THE Werkmeister Zeitung gives directions on the best treatment of driving belts, whose faultless working is of great importance in every factory. The good drawing of a belt increases with the friction between belt and pulley. Hence it is obvious that the belt must surround as large a portion of the pulley as possible. For this reason crossed belts always pull better than open ones. If in any way practicable, open belts should cover at least almost half the pulley. If



IMPERIAL ELECTRIC LIGHT CO.—SWITCHBOARD.

the circumference of one pulley be very small in proportion to the other, thus allowing the belt to cover only a small portion of the smaller pulley, a sliding of the belt frequently takes place, especially if the distance between the two pulleys be slight.

It is plain, continues the Werkmeister Zietung, that a slow running of the engine makes a strong stretching of the belts necessary. For this reason a tightening-pulley is frequently placed midway between the two pulleys, so as to avoid a repeated resewing.

If a large power is to be transmitted at little velocity, a broader belt should be employed than would be necessary with greater velocity, or else two belts are made to run on top of each other. If one does not care to tighten the belts still more or use one of the many belt lubricants, the best makeshift is to cover the pulley with sail cloth. This is done by cutting the sail cloth so exactly that it is difficult to get it on the pulley. By thoroughly moistening the sail cloth on the pulley with warm water it clings more closely to the pulley, as the water causes it to shrink. It is still more practical in the long

run to fix, instead of canvas, a leather strip of corresponding breadth on the middle of the pulley, by having a few holes bored into the rim of the pulley which are tightly filled up with wooden wedges, in order to be able to nail the strip of leather on it. This process is said to have proved useful with ordinary proportion of the size of the belt to the effect of power to be transmitted. If all is unavailing, the belt is too weak and must be replaced

MR. JULES BOURBONNIERE,
Manager Imperial Electric Light Company.

by a broader or double belt. Of great advantage in cases are the wooden belt pulleys, which increase the driving power.

## STANDARD RULES.

The committee on standard rules submitted the following report at the recent convention of the National Electric Light Association :—

"Your committee has continued the same line of policy during the past year as heretofore, viz., to discountenance any changes in the National Code of Rules not absolutely necessary ; but with the march of improvement in the electrical field some changes therein and additions thereto have been found necessary since the issue of 1897. Many of the changes made were suggested by the chairman of your commitee, and others received his approval. The policy heretofore pursued by the insurance organizations of sweeping out of existence thousands of dollars' worth of material that had been used previously with the sanction of insurance inspectors has been abandoned, and, while new and better devices and material are substituted, an opportunity is offered the manufacturer, dealer, contractor and station manager to sell and use the material and fixtures on their hands.

"The thickness of interior conduit, lined or unlined, has been established, and commercial gas-pipe taken as the standard.

"'Weatherproof' wire, so called, is tabooed for interior construction unless covered with a slow-burning material.

"A standard of thickness of insulation on wire, after a conference with the manufacturers, has been established.

"The much-vexed question of the proper distance between fuse terminals has been determined, as well as the distance between fuse metals of opposite polarity. Switches are now being standardized as to the proper breaking distance between poles, etc.

"The rules have been changed so as to permit the running of two more small motors in series multiple or multiple on constant-potential circuits.

"Rubber insulation is not now insisted on for flexible-cord pendants in dry places, but an elastic slow-burning material may be used.

Rule 40 has been so amended as to permit in dry places the use of a slow-burning insulation similar to what has been known in the past as 'Underwriters.'"

## ACCIDENTS TO STEAM BOILERS IN FRANCE.

The British Institute of Civil Engineers gives, in Foreign Abstracts, an interesting tabulated resume, taken from the official reports, of the whole of the accidents occurring to steam boilers in France during the year 1896. The information given comprises the date and situation of the accident, details of each boiler, the circumstances attending the accident, and the consequences and presumed cause of each accident.

In 18 cases defective design and workmanship was the cause of the accident, the principal defects being—1, parts made inaccessible to complete inspection ; 2, tubes of too large diameter and too thin ; 3, copper fire-box above the level of the water, and unprovided with safety appliances ; 4, copper of too thin a gauge ; 5, fire-door opening too weak; 6, supply pipes not provided with expansion joints ; 7, staybolts badly made ; 8, cast iron parts of bad design or subject to unequal expansion ; 9, plates of two low a grade for the strains to which they were submitted.

Defective maintenance was the cause of 14 accidents through—1, corrosion of plates and other parts ; 2, wear and deterioration of brass smoke-tubes ; 3, wear and defective repair of a copper fire-box ; 4, over-straining of a staybolt ; 5, defective making of joints.

Careless working caused 15 accidents, viz., in five cases through shortness of water, and in seven cases

MR. ALFRED LEPAGE,
Superintendent Imperial Electric Light Company.

through want of cleaning ; in one case through an excess of pressure, and in two cases through tightening joints while under steam. In five cases the causes of the explosion were not ascertained.

Further tables classify the accidents according to—1, the class of work for which the boiler was employed ; 2, the type of boiler ; 3, the presumed cause of the accident. The total number of accidents dealt with was 44, which resulted in injuries to 25 men and death to 16.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2299.



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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**Cost of Fuel.** THE recent increase in the price of soft coal with the consequent proportionate increase in the import duty, has proved a serious item in the expense account of large power users. The Toronto Electric Light Company, who burn something like 60,000 tons of coal per annum, propose to avoid this serious extra expense by importing in their own vessels direct from the mines a species of hard coal or culm, which, when burned with a proportion of soft coal, gives results almost equal to those to be obtained by using soft coal alone. This fuel, besides being cheaper in price, is not subject to the import duty of 25 cents per ton, which of itself is a substantial item.

**Recording Wattmeters on Switchboards.** IN a paper presented to the North-Western Electrical Association on June 26th, Mr. W. Worth Bean points out the advantages of using recording wattmeters on switchboards. These may be briefly stated thus: 1. Knowing the actual output of his station, the manager can intelligently purchase and test the quality of his fuel. 2. A check is afforded upon the work of the fireman, whose carelessness or inefficiency cannot be laid to the poor quality of the fuel. 3. The given amount of current leaving the switchboard being known, it becomes possible for the station manager to tell if his current is wasted in motors, transformers, lamps or wire connections.

**The Dodge Telephone Company.** A PARAGRAPH which recently appeared in the daily press stating that a protest had been received by the City Council from Mr. J. A. McMurtry, representing the Dodge Telephone Company, against the renewal of the agreement with the Bell Telephone Company, served as a reminder to the public that the plans of the Dodge Company for the supply of a cheap and efficient telephone service to the citizens of Toronto appear to be materializing very slowly. Mr. McMurtry, in his communication to the Council, states that he will soon be in a position to make a proposition to the city. In common with other citizens we await the early fulfilment of this promise. If the Dodge telephone system is all that its promoters claim it to be its appearance will be welcomed in a more tangible form than it has yet assumed.

**Gas Engine Tests.** IN view of the rapid development of iron production works in Canada, interest attaches to recent tests in Belgium of a gas engine of the Delaware-Debouteville type, supplied with gas directly from the blast furnaces. The engine was specially designed to operate in this manner, the cylinder being unaffected by the residuum of dust in the gas after it had been cleansed by being passed through depositing chambrse. Specimens of the gas taken from time to time were submitted to calorimetric test. The speed of the engine during first test varied from 92.48 to 94 r.p.m., and the number of admissions was exactly half the revolutions. Calculation showed that the thermal efficiency was 27.11 per cent.; that is, this figure represented the ratio between the heat turned into work and the heat available for work. The net efficiency or the ratio between the work a e brake and that of the heat in the gas consumed varied from 19.86 to 22 per cent., a figure much higher than it is possible to obtain with the steam engine. At full

load the thermal efficiency was between 25.25 and 27.16 per cent., and the net efficiency between 20.44 and 22 per cent. The mechanical efficiency of the machine was 73 per cent. at half load and 81 per cent. at full load. On the second test, the thermal efficiency was 27.34 and 27.10 and the net efficiency 20.60 and 22.17 per cent. of the total heat supplied 20 per cent. was converted into work, 52 per cent. passed away in circulating water, and 20 per cent. in the exhaust. The consumption of gas varied from 31.13 cubic meters to 31-56 cubic meters per horse-power hour.

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**Popularity of Horseless Vehicles.**

THE constantly increasing number of automobiles and locomobiles to be seen on the streets of Toronto may we presume be taken as tangible evidence of the growing popularity of horseless vehicles. The opening out of two large showrooms on the principal thoroughfares also witnesses to the oncoming of the horseless age. Still another indication in this direction is the adoption by the post office department of automobiles for the delivery and collection of mail matter from the trains and branch post offices to the general post office. Electricity, gasoline and steam are all in evidence as the propelling power for these vehicles, and it remains to be seen which method will ultimately gain the ascendency. It will probably be found that each has advantages for particular duties and circumstances.

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**The Canadian Exhibit at the Imperial Institute.**

The resources of Canada, and particularly of the province of Ontario, are by no means properly or creditably represented by the exhibit at the Imperial Institute in London. The visitor would be much more favorably impressed if the exhibits of the various provinces were placed side by side, instead of on different floors. The present arrangement does not convey the idea that Canada is one Dominion, but rather that it consists of a number of separate provinces having little or no connection with one another. The exhibit should be arranged in compact form like that of Australia. As to the character of the exhibit, and more particularly that of the province of Ontario, the richest and most important of of the provinces, there is good ground for complaint. One would suppose from the numerous views of Niagara Falls placed about the walls, that this great natural phenomenon was the one distinguishing characteristic of the province of Ontario, while the specimens of Indian work are well calculated to confirm the idea, already to prevalent in the minds of some of the people of Great Britain, that Canada is a wild and uncivilized country. Ontario is known on this side of the Atlantic as a fruit-growing province, and the quality of its production in this line is not excelled by those of any other country. In view of this fact, it is extremely humiliating to a Canadian to observe that the jars containing samples of Canadian fruit shown in this exhibit have apparently not been refilled during the last decade. What was once fruit might now, judging from appearance, be almost any other substance under the sun. There is also displayed a view of the Toronto Industrial Exhibition of date the year 1885, which, of course, conveys a totally inadequate idea of the character and extent of the Exhibition of to-day. We would suggest that all relics such as this and the photograph of the ruins of Fort Erie, might well be thrown out of the exhibit, and modern views of our principal cities and industries substituted, so that visitors would be given an approximately fair idea of the kind of country Canada is, the extent of its development, and its advantages as a place of residence and business enterprise. The Canadian Pacific Railway show some excellent views of harvesting in Manitoba. These are well calculated to make a favorable impression upon intending emigrants. There is also an excellent geological map of Ontario containing a large amount of information with regard to the population and resources of the province. There is a fairly good exhibit of building stones and marbles, also of hardwoods. Other features equally valuable might be added, so as to convey to visitors a proper idea of the country and its resources. The entire exhibit should either be rearranged, improved, and brought up-to-date, or entirely done away with.

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**The Proposed Dominion Exhibition.**

THE Executive of the Canadian Manufacturers' Association have been considering the question of the advisability of holding a Dominion Exhibition in Toronto next year. The opinion of the members of the Association has been asked as to whether the Association should go beyond this and make an exhibit at the Pan-American exhibition to be held in Buffalo. The consensus of opinion seems to be that, if the project for a Dominion Exhibition is gone on with, no attempt should be made to exhibit at Buffalo. This opinion seems well founded. If a Dominion exhibition is undertaken and carried out on a creditable scale, it will sufficiently tax the energies of the Association. It must also be borne in mind that the possibility of finding a market in the United States for Canadian manufactures is extremely small, seeing that the United have now an over-production in almost all lines of manufacture, and are looking for outlets in foreign markets for their surplus goods. We have felt for several years past that the holding of an Exhibition in Toronto, on such a scale as to attract visitors from all parts of the Dominion should be productive of much good, and if the attempt is to be made it might as well be next year as any other time. The Exhibition at Buffalo would not be likely to interfere with its success, but on the contrary might add to it, as some of the visitors to the larger exhibition might be disposed to visit Toronto also. Speaking generally, it would seem as though the Exhibition idea is likely to be carried to an extent which will eventually deprive it of any novelty or usefulness. We observe that on the heels of the Buffalo Exhibition is to come another one at St. Louis, preparations for which are already in progress. There is also to be one held next year in Glasgow. If Canada is to have an Exhibition on a national scale, it would be as well to launch the enterprise at once, so that we may not come in at the tail of the procession.

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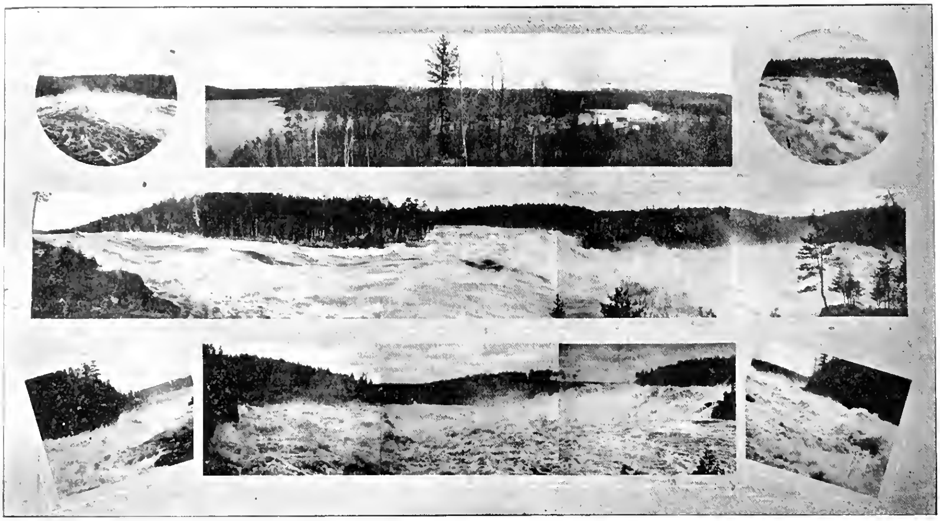
At the last regular meeting of the Engineers' Club of Toronto, a discussion took place, led by Mr. James McDougall, C. E., on "Freight Traffic on City and Suburban Tramways."

The only tender received by the city of Toronto for electric lighting was that of the present contractors, the Toronto Electric Light Company. The company offer, in the event of the present contract being renewed for five years, to provide the service at $71.90 per lamp, per year, and for a ten years' contract at $65.70 per lamp, per year, using enclosed arc lamps. A tender was also submitted by the Kitson Incandescent Company for the Kitson incandescent light at $90 per year. The council have employed Mr. G. R. Rosebrugh, of the Electrical Department of the School of Practical Science, to test and report upon the comparative illuminating power of the Kitson light as compared with that of the electric lamps now in use.

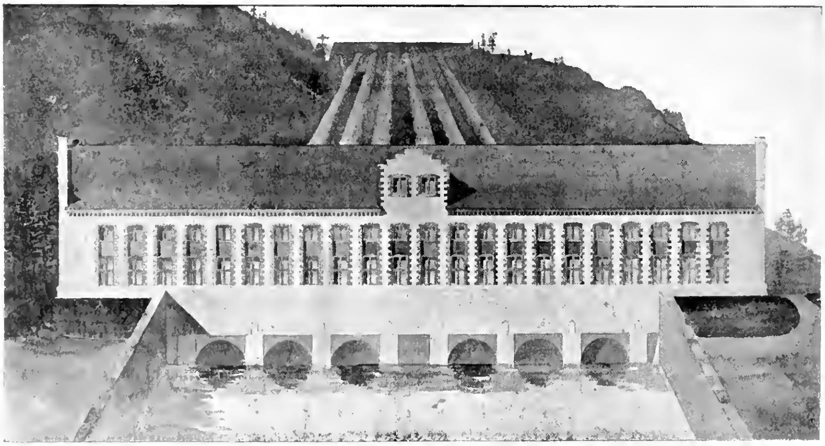
## THE SHAWINIGAN WATER AND POWER COMPANY.

The following description of the extent of the proposed operations of the above company and of the hydraulic work in connection with the extensive plant which they propose to install at Shawinigan Falls, is abstracted from a recent issue of the Engineering Record. At a later date particulars will also be given of the electrical plant.



VIEW OF THE SHAWINIGAN FALLS.

The St. Maurice River is a stream draining 18,000 square miles of heavily timbered country on the north side of the St. Lawrence River, into which it empties at the city of Three Rivers, situated about half-way between Quebec and Montreal, the distance to either of these cities being 90 miles. About 15 miles back from the St. Lawrence, this river, in breaking through the Laurentian hills, forms in a distance of 15 miles a number of falls and rapids, which with the heavy flow of water obtainable, are capable of development into power at a very low capital cost. A minimum of 200,000 horse-power can be developed here at the lowest known water, even after allowing a liberal proportion of the flow for the carrying away of frazil or anchor ice during the winter. As the low water in this region unfortunately occurs in the winter some allowance of this kind has to be made. Owing to the lack of railroad communication, these desirable properties have lain fallow, but the opening of the Great Northern Railway of Canada, which will give the best of them direct communication with Quebec, Montreal and Ottawa, and thus open them to the world, has made their commercial development feasible. The city of Three Rivers is open to ocean navigation for eight months in the year, and it is not improbable that at no other seaport in the world is there a power of such magnitude within a radius of 30 miles. A portion of this power has already been developed at Grand Mere, distant 30 miles from Three Rivers, where it is utilized under a head of 40 feet in the operation of a pulp and paper mill, having a capacity of 100 tons of paper and 50 tons of pulp daily.

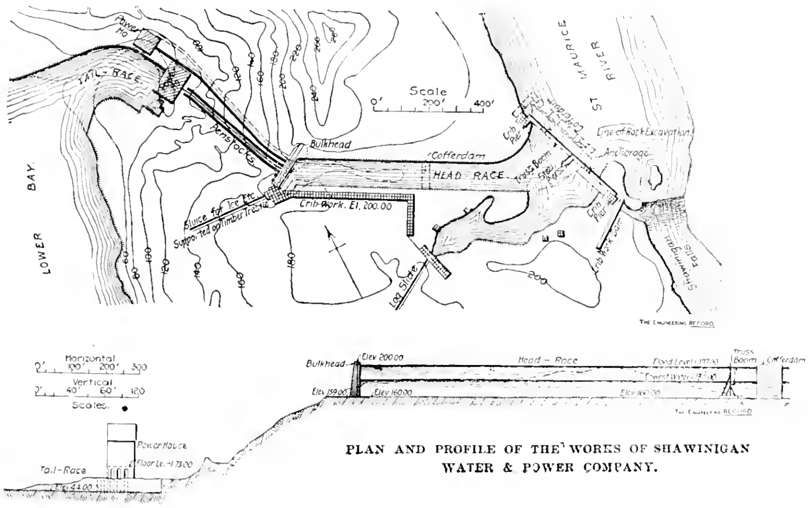


VIEW OF THE POWER HOUSE.

The most important power location, however, is that

at Shawinigan Falls, a cascade having a fall of 140 feet in a very short distance. The normal flow of the river at this point is 24,000 cubic feet per second, and 100,000 horse-power can be developed and utilized at the very lowest water. The Shawinigan Water & Power Company has acquired the whole of this power from the Government, and is developing it on a large scale.

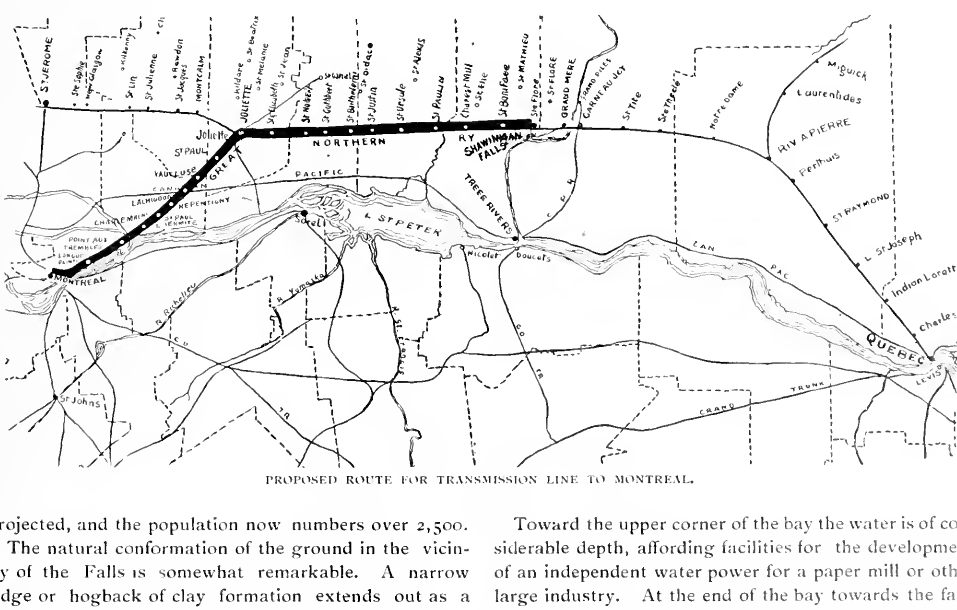
mile in length, with a width from 600 to 1,000 feet. This ridge, along which the railway is carried, was originally only 5 or 6 feet wide on top in places, falling away with slopes of $1\frac{1}{2}$ to 1 on each side, and although formed of nothing but blue clay has withstood the pressure of water coming within 20 feet of the crest at high whter, the distance through the section of the ridge




PLAN AND PROFILE OF THE WORKS OF SHAWINIGAN WATER & POWER COMPANY.

It has acquired large tracts of land in the vicinity, built a standard guage branch $4\frac{1}{2}$ miles long through rough country to the Great Northern Railway, with sidings, turntable and terminal facilities, and has been working throughout the past winter on an initial development of 30,000 horse-power with a head-race and intake of sufficient capacity for extension to 60,000 horse-power. A town site has been laid out, and its improvements

from water to air being not over 60 feet. Borings taken for a depth of 80 feet below water during the past winter show nothing but blue clay. This bank was, however, being carried away slowly by erosion, and must at some future date have broken through. After building the railway along the ridge the bank has been thoroughly rip-rapped with loose stone from the excavation in the head-race, thus obviating all danger of this kind.




PROPOSED ROUTE FOR TRANSMISSION LINE TO MONTREAL.

projected, and the population now numbers over 2,500.

The natural conformation of the ground in the vicinity of the Falls is somewhat remarkable. A narrow ridge or hogback of clay formation extends out as a peninsula separating two bays of the river forming the upper and lower levels of the Falls, between which there is a drop of 140 feet. A small stream, called the Shawinigan River, falling into the lower bay, carries this peninsula still further back, making it nearly a

Toward the upper corner of the bay the water is of considerable depth, affording facilities for the development of an independent water power for a paper mill or other large industry. At the end of the bay towards the falls the water is shallow, with large sand bars which would render any development at that end exceedingly expensive and troublesome to maintain.

Just above the Falls the river is divided, by a large island, into two channels, both of which converge half

way down the Falls. The united waters strike directly into the face of a rock cliff and turn at an angle of about 110 degrees to their course, forcing their way through a narrow gorge, in which there is a drop of 25 feet, into the lower bay.

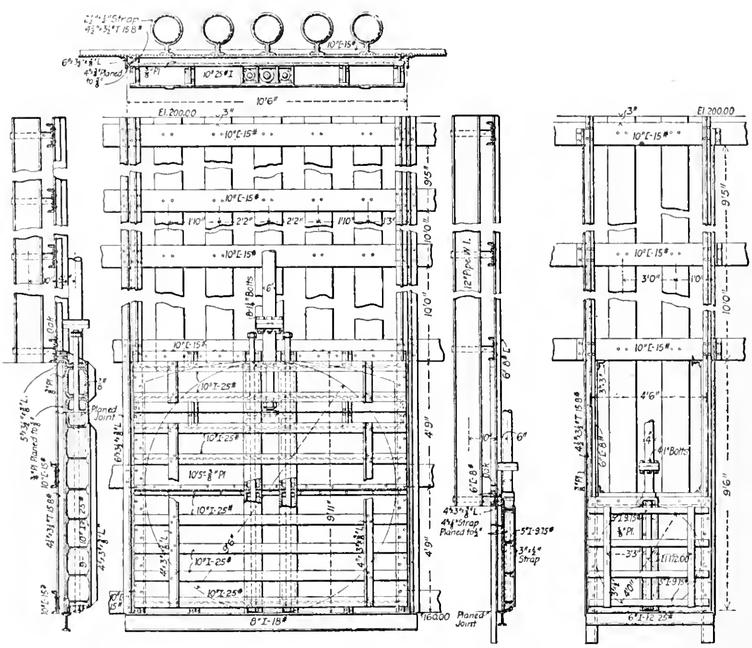
The present development consists of an intake canal or head-race about 1,200 feet long cut through rock from a point just at the head of the Falls and running back at an angle of 135 degrees with the course of the river, with a glance boom to deflect floating debris and ice over the Falls, terminating with a heavy masonry bulkhead from which the water is carried in large steel penstocks to the power-house below.

This canal is funnel shaped for about 500 feet of its length at the entrance and beyond this has a width of 100 feet by a depth sufficient to give 20 feet of water at the lowest known level.

The sides are formed by the natural rock, above stone for about half its height. A talus of gravel is to be laid along the outstream side extending over to the edge of the excavation. All bolting was done with ⅞-inch round spikes driven into ¾-inch holes, bored by a pneumatic boring machine.

At the end of this crib, next the bulkhead, is placed an ice chute to carry off drift ice and trash from the racks, and the crib being 40 feet high at this point, is 30 feet wide. Cribwork was used along this side of the canal so as to be easily removed when the canal is widened and the bulkhead extended for additional penstocks required to develop 60,000 horse-power.

The entrance to the head-race is protected by a heavy glance boom in two sections, each 220 feet long, supported by two heavy crib piers at the ends and by a steel structure at the center. The cribwork piers are 30 x 30 feet square by 26 feet high, and are built of 12 x 12-inch pine face timbers, laid to 2-inch spaces, with



GATE AT HEAD OF PENSTOCK.

which they are carried up to a height of 40 feet by a dry-stone wall on the right hand side, on which the natural ground is high, and by a timber crib-work wing dam on the left hand side. The dry wall is built of heavy stone with vertical stepped back, the face being battered 2 inches to a foot. This wall is from 6 to 20 feet high, and is filled in behind with loose stone and gravel as as to form a road along the bank of the head-race.

The cribwork dam, 15 feet and 20 feet wide and from 10 to 23 feet high, is built of 12 x 12-inch pine face timbers, laid 2 inches apart, with 10-inch round pine cross-ties 10 feet apart in each course and staggered in alternate courses so as to form 5-foot pockets, and with 6-inch flattening longtitudinal stringers running through the center. This dam is faced with two layers of dressed pine plank, 2 inches thick. Both the face timbers and sheetings are closely scribed to the rock, and the dovetailing of the ties into the face timbers and general fitting is of a superior character. The crib is filled with stone very closely packed and is backed with 6-inch flattened cross-ties 10 feet apart in each course, staggered in alternate courses. They are faced with 6-inch oak on the outstream and upstream sides, and each of them has two elm mooring posts 20 inches in diameter, capped with cast iron. The bottom timbers are bolted down with 24 fox-bolts 1½ inches in diameter running 5 feet into the rock.

The steel bottom pier consists of a bent of two vertical posts, each made of a pair of 15-inch channels 38 feet two inches long. These uprights are 22 feet apart in the line of the boom, and are braced with horizontal and diagonal struts, and sway bracing in every direction, particularly, of course, in the direction of pressure at right angles to the line of the boom, the connections being made with gusset plates riveted between the webs of the channels. The bases of the bents are each formed by two pairs of angles set up on concrete piers. These bases are anchored down with 1½-inch fox-bolts 10 feet long, running 6 feet into the rock and having a cross piece to set into the concrete base

piers. Half-round rubbing pieces are provided to allow the boom to slide smoothly up and down, and heavy shackles are provided to which the boom chains will be secured.

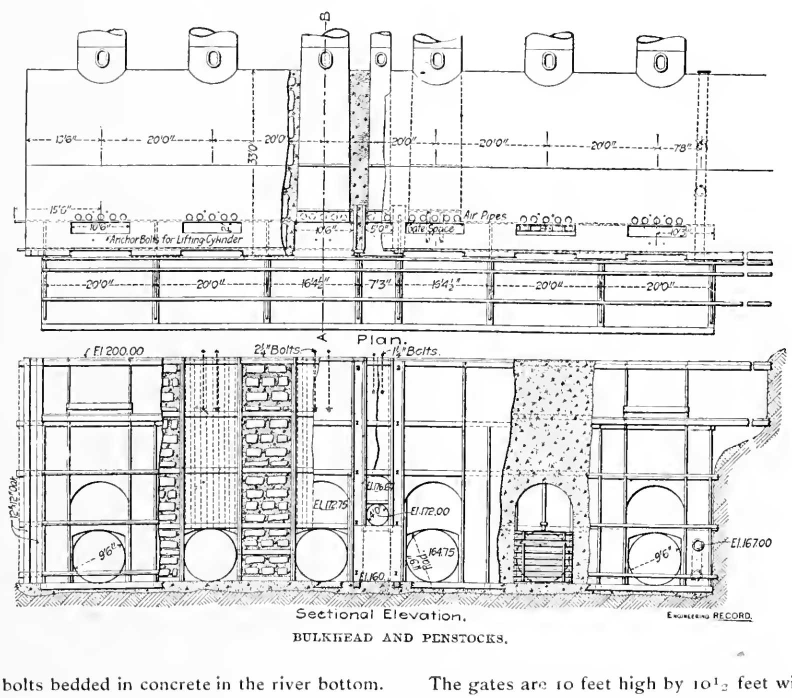
The boom is made in the form of a Howe truss, there being two sections each 220 feet long, 4 feet deep and 10 feet wide. The face timbers are three courses of 12 x 12-inch timbers with 3-inch plank laid solid between, diagonally, forming the main bracing, the counter-bracing being formed by 4 x 12-inch timbers on edge spiked to the main bracing. The truss is divided into 10-foot panels and bolted with iron bolts 1¼ inches to 1¾ inches in diameter with plate washers. On the outstream side the boom is faced with 3-inch tamarack plank laid longitudinally to take up the wear of the ice, etc.

Heavy ring bolts are provided for securing the boom to the mooring posts. The main anchorage for the boom, however, will be 1½-inch steel chains secured to

A smooth face in concrete will be formed by laying 3 inches of 3 to 1 cement mortar against the forms, holding it in position by a light steel plate, then laying up concrete and drawing the plate, ramming the whole lightly together after the heavy ramming of concrete is completed.

The penstocks will be carried through the bulkhead in slightly conical shape, being 9 feet 6 inches in diameter at the mouth by 8 feet 6 inches where they project from concrete. There are six of these large penstocks, each of 5,000 horse-power capacity, and one of 3 feet 6 inches in diameter for the exciter wheels.

The danger of collapse from atmospheric pressure through sudden shutting of the gates and the withdrawal of water from the pipes, is provided against by having five vertical air pipes, 12 inches in diameter, extending up from the mouth of the pipes to the top of the bulkhead behind the gates. Two cut-off rings are placed on the outside of pipe to set in the concrete.




BULKHEAD AND PENSTOCKS.

heavy ring bolts bedded in concrete in the river bottom. These are placed so that the boom will engage the boom piers at all heights of water and have a tendency to keep toward the piers. The chains secured from the ring bolts to the piers give double safety against the possibility of losing the boom.

The bulkhead is to be built of what may be called concrete rubble. The bottom under the bulkhead is solid rock, and on this will first be laid a footing of 1:2:5 concrete extending 25 feet in front of the bulkhead. On this the steel rack framing, gate slides, pipes, etc., will be set up, and the concrete bulkhead will then be placed. This is 32 feet wide on the bottom by 15 feet wide on the top, and the masonry is composed of heavy blocks of stone laid with at least 12 inches of concrete between, composed of 1 part cement, 2 parts of sand and 5 parts of fine broken stone. All stone must be kept back 12 inches from the face of the bulkhead, and any stone showing a face of over 4 square feet must be kept back 18 inches from the face.

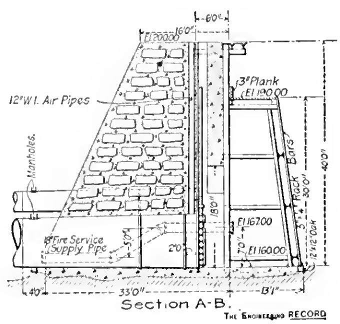
The gates are 10 feet high by 10½ feet wide, and are built of ⅜-inch plates on a framework of 10-inch I-beams, and slide on steel vertical strips bearing on T-bars riveted to channels bedded in the concrete. They are to be raised by pneumatic pressure from the power-house below, with properly regulated pistons to avoid any danger to the pipes through too sudden opening or closing of the gates. Each gate has a single shaft connected to two rods running through the whole height of the gate, and is so made that on commencing to raise the gate a section 12 inches high separates from the balance of the gate, and allows the penstock to fill with water, after which the whole gate is lifted together. The pneumatic pistons are designed, however, to open and close the gates under the total possible pressure due to a head of 40 feet.

The gate for the exciter pipe is of the same design but on a smaller scale.

In addition to the gates the penstock entrances are protected by stop logs formed by 12-inch channel slides

into which 12 x 12-inch timbers can be dropped in case of emergency.

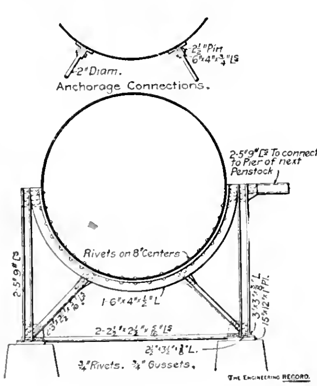
The rack framing is formed of trestles of I-beams set on oak stringers bedded in concrete in the bottom. Three lines of 15-inch I-beams, running horizontally, support the rack, which is laid on a batter of 3½ feet in the height of 28 feet and is formed by 3x¼ inch bars spaced at 2-inches centres, with thimbles between, in sections 3 feet long. These sections are separated, and are supported on cast-iron blocks, bolted to the oak




SECTION THROUGH PENSTOCK.

sill, of such a design that the section can be removed and replaced without the services of a diver. The sections are secured at the top against overturning by a hasp engaging in a staple spiked to the flooring of the rack platform. This platform is set 10 feet below the top of the bulkhead at a height where the rack can be raked conveniently for a greater part of the year.

Another narrow platform is set level with the top of the bulkhead. The ice chute previously mentioned forms a convenient means of disposing of all trash raked from racks, which can be worked along the racks and into the chute. A light glance boom will be placed




SADDLE CARRYING PENSTOCK.

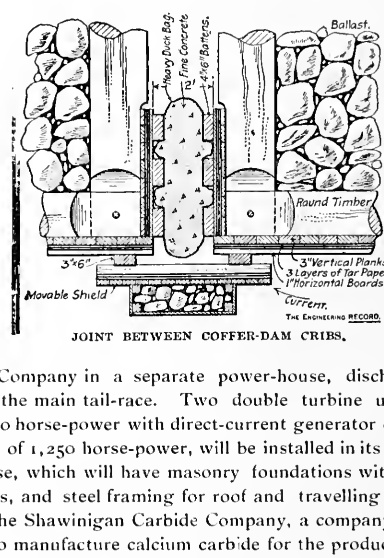
in the head-race leading to the ice chute, so that no floating debris will come against the racks. The height of water floating through the ice chute will be regulated by stop logs at the entrance.

Three of the large penstocks, two of them 500 feet long and one 650 feet long, will be laid at once. They will be lap-jointed on both longitudinal and girth seams at upper end, lap-jointed on the girth seams and but-strap jointed on the longitudinal seams at the lower end. The plates are 5/16 inch in thickness at the upper end and 7-16 inch at the lower end. The pipes will be supported on steel saddles 15 feet apart, riveted to the pipe and resting on concrete base piers. These saddles are built of channels and angles, with gusset plate connections. The angles on which the pipe rests being curved to fit the pipe. The bases of the saddles will be held down with 1-inch fox-bolts running through the piers into the solid rock. The saddles are designed to receive bolting and framing of wooden housing for the pipe. This housing is necessitated by the extreme cold and will also obviate trouble through expansion and contraction due to the changes of temperature. Anchor rods secured to angle connections on the pipe and to fox-bolts in the rock will counteract the tendency to slide down hill.

Two of these pipes will run to the main power-house of the company where they will each operate horizontal double turbine units of 5,000 horse-power with single generator units of the same capacity. The electrical apparatus will be supplied by the Westinghouse Electric & Manufacturing Company and the turbines by the I.P. Morris Company, Philadelphia.

The power-house foundations will be of massive rubble masonry in cement mortar and concrete. The walls will be built of stone, supporting steel roof trusses and track beams to carry an electric travelling crane of of 50 tons capacity.

The third pipe will be used by the Pittsburg Reduct-




JOINT BETWEEN COFFER-DAM CRIBS.

ion Company in a separate power-house, discharging into the main tail-race. Two double turbine units of 2,500 horse-power with direct-current generator on each end, of 1,250 horse-power, will be installed in its power-house, which will have masonry foundations with brick walls, and steel framing for roof and travelling crane.

The Shawinigan Carbide Company, a company formed to manufacture calcium carbide for the production of acetylene gas, has leased 10,000 horse-power with an option on 20,000 horse-power additional. It will erect works one mile from the power-house along the main line of the railway, its first building being a 150 x 900-foot structure, on a masonry foundations.

General surveys for the present development were conducted under circumstances of great hardship during the winters of 1897 and 1898, and during the summer of 1899 other extensive surveys were carried out, including those for an electric railway to Three Rivers and the location for the branch to the Great Northern Railway. The contract for the railway branch and work on the first development, including excavation, cribwork and masonry was awarded on May 15, 1899, to the Warren-Scharf Asphalt Paving Company of New York.

On May 23, 1899, work was commenced by opening up a wagon road 2½ miles long into the Falls. Work

on the excavation in the head-race and the tail-race was commenced about August 1, 1899, and has been continued ever since, with the exception of about two weeks lost through an abnormal flood in October.

The head-race excavation was taken out by 12 guyed derricks, 55-foot booms, six on each side of the cut, set about 120 feet apart. These derricks, together with spoil tracks, were set on top of the bank about 40 feet above the finished bottom of the cut.

At the intake a temporary coffer-dam had to be constructed. This was commenced about September 15, after the logs had passed down the river, and was placed in six weeks' working time, being delayed about one month by the flood before mentioned.

This coffer-dam is 640 feet on the water line by an extreme height of 30 feet, and was placed, without accident of any kind, in a current running at from 3 to 5 miles per hour. It was placed 15 feet away from the limit of excavation, and extends right over to the top of the Falls. The sand and gravel, 5 or 6 feet in depth in deep water, was first removed by means of a 6-inch centrifugal pump, set on a scow with separate boiler and engine, and discharging into midstream. This sand and gravel was thoroughly cleaned off, so as to allow the cribs to set on solid rock.

To cut off the current through the opening, due to the water being lower on the inside than on the outside of the cribs, stop-gates were run down on the outside of the openings between the cribs. These gates were about 4 feet wide and 30 feet long. They were made of two layers of 2-inch plank with tarred felt between, and laid against vertical bearing strips on each crib, A ballast box on the outside of the gate was filled with stone and the gate sunk into position when the pressure of water made it bear tightly. The bolting of this coffer-dam was done with ⅞-inch round spikes driven into ¾-inch round holes.

The coffer-dam has proved so tight that the head-race behind it has been easily kept dry by one 8-inch centrifugal pump working at about half speed.

After the work of excavation is completed, the rock filling will be removed from the cribs with an orange-peel dredge bucket, and the timber taken off or allowed to go over the falls so as to leave no obstruction whatever at the entrance to the head-race.

It was originally expected that the bulkhead at the lower end of the head-race would be built simultaneously with the excavation in the head-race, but for various reasons was delayed until the frost made the laying of concrete inadvisable, and provision had to be made for its construction this spring.

The coffer-dam at the intake is exposed to the full force of the open river, and is not calculated to stand against floods, nor is it high enough to exclude high water. Further, it reduces the flood overflow area of of the river by one-half, and any attempt to raise it would increase the flood level of the river to a dangerous height. Therefore, a second cribwork dam has been constructed across the head-race, and it will protect the bulk-head site after the outside coffer-dam has been removed.

The coffer-dam is a single continuous crib built across on the level bottom of the head-race, and extended on the top of the bank on both sides to the high ground on the one side, and the cribwork permanent wing dam on the other side. This dam is 27 feet wide for a height of 23 feet, and 16 feet wide for its remaining height of 17 feet. It is of the same description of cribwork as the coffer dam at the intake, and is sheathed in the same manner.

Cross ties are framed 10 feet apart in each course, and staggered in alternate courses, forming 5 x 11-foot ballast pockets. These are filled with loose stone closely packed, and loose stone has also been piled on top of the offset between the widths of 27 feet and 16 feet, making the dam practically 27 feet wide from top to bottom. The joint between the crib and the rock sides and bottom is made with concrete and puddled clay, the clay in vertical corners being held in place by corner boards. Two flumes about 2 feet square are carried through the crib to admit water when required.

Another coffer-dam has been built in the tail-race to hold back high water while the power-house foundations are being built. This dam is 26 feet high, with cut-offs through the gravel to rock at each side, and is 200 feet long; 160 feet of its length, where it rests on a clay bottom, is built with an inclined top in bents of heavy rough timber on 4-foot centres. This dam is 80 feet wide on the bottom. The covering is 2-inch and 3-inch dressed plank covered with two layers of tarred felt protected by 1-inch boards, the felt and the joints in the boards being swabbed with hot pitch. The toe of this dam is made tight with double sheet piling well puddled. The remaining 40 feet of the dam is formed of square cribwork, as previously described, 20 feet wide.

Water from the river is pumped by a Northey pump with 3-inch suction, and delivered to two storage tanks, one of which has a capacity of 2,000 gallons, and is elevated 75 feet. Service pipes from it supply boilers on both sides of the head-race.

There is a 15-arc light dynamo from the Royal Electric Company, Montreal, driven by a 35 horse-power Laurie automatic engine, and lamps are placed on each side of the cut for night work.

There is a camp for boarding 300 men. The maximum number of men employed has been about 1,200. In the summer it was difficult to keep the men on the work, but they were anxious to work through the severe winter weather, and the rock excavation and crib building was carried on almost uninterruptedly with a force of over 1,000 men.

Messrs. T. Pringle & Son, Montreal, are the engineers of construction: Mr. Wallace C. Johnson, Niagara Falls, is the consulting hydraulic engineer, and Mr. Wm. I. Bishop, Montreal, is the engineer in charge. Mr. D. A. Rexford is the contractor's superintendent.

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At the annual meeting of shareholders of the Ottawa Electric Company a very satisfactory statement was presented. The company has now installed 87,114 incandescent lights, 644 arc lights, 163 motors, and 23 heaters, all distributed among 4,357 customers. This is a substantial increase over last year. During the year there was installed an electric storage battery of 250 cells which is employed as an auxiliary to the motor service. The board of directors were relected.

Mr. James Kent, general manager, and Mr. B. S. Jenkins, general superintendent, of the C. P. R. Telegraph Co., have recently returned from a tour of inspection of the company's lines in the Northwest and British Columbia. Mr. Kent states that additional wire facilities of 1,000 miles will be provided this year to meet the increasing demands of the trade. A new wire has been put up between New Denver and Nelson, in the Kootenay, which will allow the duplicate system to be worked from Vancouver to Nelson and Rossland, and so double present facilities. The wires of the Manitoba and Northwestern system have been extended into Winnipeg, thus giving direct wire service between Winnipeg and all points on the Northwestern branch system.

## MR. ALBERT MITCHELL.

As one of the many Canadians who have secured responsible positions in far-off lands, we present a portrait of Mr. Albert Mitchell. A few months ago Mr. Mitchell succeeded Mr. H. J. Somerset, as superintendent of the Winnipeg Street Railway, Mr. Somerset having been appointed manager of the street railway system at Perth, Australia. Mr. Mitchell subsequently resigned his position in Winnipeg to become superintendent of the street railway at Perth, a position carrying with it greater responsibilities and increased salary.

Mr. Mitchell spent his early years in Ontario, but left his home to learn the mechanical trade with the Vulcan Iron Company, of Winnipeg. He had only a common school education, but while learning his trade he took every opportunity to add to his store of knowledge and afterwards took a course in engineering and electricity in a technical school. He worked at his trade for twelve years and spent one year in building electric motors. In 1896 he accepted the position of chief engineer of the Winnipeg street railway, holding same until his appointment as superintendent. We bespeak for him success in his new field of labor.

Mr. Albert Mitchell.

## BY THE WAY.

The following story is told by W. S. Churchill in his "The River War", of the manner in which General Kitchener improvised a reel for field telegraph work in the Soudan. "He walked to the largest coil of wire picked it up and approached the smallest donkey. He took the little animal's two hind legs in his left hand, and put them into the coil. He lifted the wire up until it passed around the donkey's back, like a horse collar, only that it hung between the fore and hind legs. He caught hold of the loose end of the wire and smacked the donkey with the other hand. The beast moved forward, tripping and stumbling over the wire, which began, albeit jerkily, to unwind. Then he walked abruptly back to his horse. By this method the Field Telegraph accompanied the Flying Column."

Mr. V. L. Emerson, of Ottawa, is reported to have invented a powerful automobile, which is designed to be operated by a hydro-carbon motor, at a speed of 30 miles an hour.

Under the direction of Mr. L. M. Lash and Mr. P. F. Sise, of the Bell Telephone Company, Montreal, a large new switchboard is being installed in the head office of the New Westminister and Burrard Inlet Telephone Company, of which Mr. H. W. Kent is the general superintendent. The cost of this new switchboard will be about $30,000.

## PERSONAL.

Mr. Wilfrid Phillips has resigned the position of manager of the Niagara Falls Park & River Railway.

The authorities of Columbia University have granted for the third time the Tindall Scholarship to Prof. R. B. Owens, of McGill University.

Mr. Wm. Marconi spent the greater part of last month in Ottawa. He has returned to Europe but is expected back again a few months hence.

Mr. Thos. Ahearn, of Ottawa, accompanied by his family, is on his way to Europe. He will visit the Paris Exposition and spend some time in England and Scotland.

Mr. R. W. Angus, B.A., son of Mr. R. Angus, superintendent of E. Leonard & Sons, London, has been appointed lecturer in mechanical engineering in the School of Practical Science Toronto.

The death is announced at Brantford, Ont., of Mr. W. Barron, who was for many years manager of the Brantford street railway. The deceased had been some time previous to his death in poor health.

Mr. John G. Ridout, of the firm of Ridout & Maybee, patent solicitors, Toronto, has been awarded a premium by the Chartered Institute of Patent Agents, London, Eng., for one of the five best original papers read before the Institute this year.

Mr. P. McCullough, electrician at the power house of Toronto Railway Company, has resigned his position, and left on June 24th to take charge of the electrical department of the corporation tramways at Liverpool, England. Prior to his departure Mr. McCullough was presented with an illuminated address and a gold chronometer by the electrical and mechanical staff of the railway.

## SPARKS.

A fire which occurred a few days ago in the sub-station of the Lachine Rapids Hydraulic and Land Company, Montreal, caused considerable damage to the machinery, and resulted in the death of the watchman.

The Dominion government have awarded the contract for a cable to connect Belle Isle with the Canadian telegraph system. The cable will be delivered in Canada within six weeks and within a month thereafter will be laid.

The gas and light committee of the Brockville city council have offered the sum of $85,000 to the Brockville Light and Power Company for its plant. The company have accepted the offer on condition that the council will pay for recent extensions, tools, and stocks at the cost price.

The Board of Control, of the Toronto city council, have passed a resolution recommending the city engineer to prepare an estimate of the cost of installing and operating a municipal telephone system for 6,000 and 10,000 subscribers. A committee of the council has also been appointed to consider the question.

Mr. Wm. Mouall, of Montreal, who is a member of the syndicate controlling the street railway franchise in Havana, has recently returned from Cuba. He states that the Cuban electric railway enterprise, in which Halifax and Montreal capitalists are interested, is showing satisfactory results. The net receipts for the first month's operation amounted to $6,000. The company are constructing a new line three miles long to the city of Gaunadacoa, where it is proposed to establish a pleasure park.

The Toronto Electric Light Company are having a tunnel constructed beneath the railway tracks on the Esplanade immediately opposite their works, in which to place the cables connecting with their underground system. The company, during the present year, have laid vitrified clay conduits enclosing cables on a number of the principal thoroughfares, including Front street, King and Queen streets as far west as Spadina avenue, Yonge and Queen street and up Terauley street to their station on that street.

The Bell Telephone Company have notified the fire department of Toronto to remove all fire alarm wires from the company's poles, otherwise they will hold the city responsible for any resulting damage. There are in use in the fire alarm system 879 poles belonging to the Bell Telephone Company, 479 poles of the G. N. W. Telegraph Company and 869 of the Electric Light Company. The G. N. W. Company has rendered an account for $200 for the use of its poles. The Electric Light Company says the city is welcome to use the wires free.

The project for the construction of an electric railway from Port Dover to Preston, via Simcoe, Waterford, Boston, Mount Pleasant, Brantford, Paris, Ayr, Blair, Doon, Berlin and Preston, is being brought prominently before public notice. It is proposed to acquire the Brantford Street Railway covering the City of Brantford, the Galt, Preston and Hespeler Electric Railway, with which connection will be made at Preston for Galt and Hespeler, and the Berlin and Waterloo Electric Railway with which connection will be made at Berlin. Connections will be made at Port Dover with the Shenanago Car Ferry running to Conneaut, or Erie, on the American side of Lake Erie; at Simcoe with the Wabash Railroad; at Waterford with the Michigan Central Railway and Toronto, Hamilton and Buffalo Railway; at Brantford with the Toronto, Hamilton and Buffalo Railways; at Ayr and Galt with the Canadian Pacific Railway. The total cost of the road is placed at $1,500,000. It is stated that the greater part of the capital required has already been arranged for, and application is now being made for bonuses from the municipalities along the route.

# ENGINEERING and MECHANICS

## UTILIZATION OF EXHAUST STEAM.*

By E. P. Roberts.

Among the uses to which exhaust steam may profitably be put is heating the feed water. The heating of the feed water is the most common use, but it is not always understood how small a portion can possibly be utilized in this manner. If we have 3,000 pounds of water and the initial temperature of the feed-water be 60 degrees f. and the exhaust steam pass through the heater at atmospheric pressure it will heat the water to about 200 degrees f. For each pound of feed-water we merely require 140 heat units or a total of 420,000, or approximately one seventh. Evidently there will still be a large surplus. Often feed-water is not heated as hot as it might be without cost, and in such cases the saving to be made by the addition of suitable apparatus for raising the temperature of the feed-water will pay large returns on the investment. Having used all the exhaust steam needed for heating the feed-water there will still be a balance which may be disposed of in any of the following ways:

First, exhaust it into the atmosphere. Second, condense it and obtain the greater economy on the engine. Third, use it for heating buildings, etc., which to do in any instance will depend entirely upon the local conditions.

Upon the supposition that sufficient money is available for such improvements and extensions as will bring the largest percentage-returns on the total expenditure, a general statement can be made. Determine the first cost and additional cost of the operation, including in operating expenses an allowance for depreciation and repairs and determine the gross income; the difference between the above will be the net profit. This is a simple proposition, but an accurate de rmination of the result requires a most careful examination of all the details of the proposition, and is far from being a simple matter. The second possibility is usually the easiest of determination. It is the advisability of condensing. The first step is to ascertain the existing conditions: First, how much steam is being used? Second, the range of load—the nearer the average load is to the rated, the greater the economy from condensing; on a very light load, condensing may cause a loss. Third, what pressure is carried, and what can be carried, and how long are the boilers good for such pressure? Fourth, are the engines overloaded at times, so that more power is needed? Fifth, are the boilers overloaded? Sixth, is it possible to install new boilers or engines? What will it cost? Will the results cost more and be better or worse than if made condensing? Seventh, what will it cost to put in a condensing system? Is water available without cost except pumping? If not what will a cooling tower cost? Eighth, what is the character of the water? If bad, will not surface condensers save a considerable amount by lessening scale in the boilers?

These are the more important points to be considered and the value of each determined accurately, when the profitable utilization of the exhaust steam other than heating the feed-water is to be decided upon.

To find the largest expenditure for the condensing system that can be made to obtain a saving of one per cent., first find the total cost of fuel for the year. One per cent. of this amount will represent the interest on the maximum amount that may be expended in obtaining a net saving of one per cent.

The next consideration is the use of exhaust steam for heating buildings, etc. The subject of charges for heating is one deserving of considerable attention. Mr. Roberts in speaking of this matter said: "The correct basis of charge is evidently the amount of steam furnished. This evidently requires meters. Steam meters until recently, have been of the velocity type, and have given a greater or less degree of satisfaction, that is for meters. Meters are now made which record the water of condensation, and this is a correct measure. But exclusive of meter measurements, flat rates can be made in the heating business on a far more satisfactory basis than in lighting. Such basis is the the square feet of heating surface, and is fairly satisfactory, because a square foot will condense a certain amount of steam, and although such amount depends upon the initial temperature of the air to be heated, nevertheless the average for the year can be quite closely approximated. The principal objection to this basis is that customers are liable to regulate the temperature, not by closing off the steam but by opening windows. But even such objection is not a very important one when there is sufficient exhaust steam for use in the coldest weather, because it is the coldest weather which determines the maximum and at such time windows are not opened.

Sometimes the charge is based on the cubic feet of space to be heated. This is a very crude basis as in one case one square foot of radiating surface may be needed for 60 cubic feet of space and in another case we may heat to the same temperature 120 cubic feet or more. These figures refer to direct radiation. For indirect radiation, fan system, etc., the amount will be changed. By far the majority of steam heating is by direct radiation, although in any installation of considerable magnitude consideration should be given to each of the above methods."

The rules for heating of buildings are many and various but the following are given as having been found reliable in practice. Allow one-fourth square foot of radiating surface for each $\frac{1}{100}$ of the cubic contents for first floor rooms and halls; the same amount of radiating surface for each $\frac{1}{150}$ of cubic contents of room for second and upper floor rooms, and one-fourth square foot of radiating surface for each square foot of glass surface plus that of exposed wall. Wolff gives the following allowance for special conditions: Increase ten per cent. for northerly exposures subject to wind, and ten per cent. when the building is heated during the day time only and when the building is not exposed. Increase 30 per cent. when the heating is done in the day time only and when the building is much exposed. Increase 50 per cent. when the building is heated during winter months intermittently at long intervals. The above factors make a considerable modification and what factor to use in any given case is a matter of judgment based on experience.

*Abstract of paper read before the Ohio Electric Light Association.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

### Toronto No. 1.

At the last regular meeting of Toronto No. 1 Canadian Association of Stationary Engineers, held on June 20th, 1900, the following officers were elected for the ensuing year,—President, J. Huggett; vice-president, W. J. Webb; recording secretary, J. Marr; financial secretary, N. Kuhlman; treasurer, S. Thompson; conductor, W. Butler; doorkeeper, G. D. Bly; trustees, G. Mooring, C. Moseley, Jas. Bannon; delegates to convention, J. Huggett, W. J. Webb, H. Terry, A. Storer, N. Kuhlman.

### Hamilton, No. 2.

At the last regular meeting, June 19th, 1900, the following officers were elected:—President, Thos. Chubb; vice-president, F. J. Scutthorp; recording secretary, Jos. Ironside; financial secretary, Jas. Carrol; treasurer, W. R. Cornish; conductor, Jas. Wadge; door-keeper, Jas. Cook; delegate to convention, Bro. Geo. Mackie; alternate, Geo. Dawson.

### Annual Convention.

The eleventh annual Convention of the Canadian Association of Stationary Engineers will be held in Toronto, commencing August 21st next. The meeting place will likely be the Engineers' Hall, 61 Victoria street. The local Association have already made preliminary arrangements for the entertainment of the delegates, and one of the most successful conventions yet held is predicted. In next issue further particulars will be given.

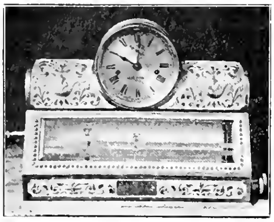
The Canadian Association of Stationary Engineers, of Montreal, have elected the following officers for the ensuing year:—President, H. F. Thompson; first vice-president, F. D. Jones; second vice-president, H. Wady; secretary, past president W. Smythe; treasurer, past president T Ryan; financial secretary, H. Nuttal; conductor, J. Carr; doorkeeper, H. Knight; trustees, past president J. J. York, past president G. Hunt, past president W. Weir.

The Electric Reduction Co., Buckinghem, Ont., is installing two 25 k. w. direct current generators supplied by the Royal Electric Co.

## THE MARTIN AUTOMATIC RECORDER AND REGISTER.

This device, as shown in the cut, is for drawing load curves, such as the total output of one or more switchboards, also to check the time when the readings are taken. The recorder carries a two months supply of cross section paper, made up in the shape of daily charts (Fig. 2). These charts pass out at the back of the recorder, once every twenty-four hours. They are kept moving at the same rate as time by the clock, which is geared to the roller which carries them forward.

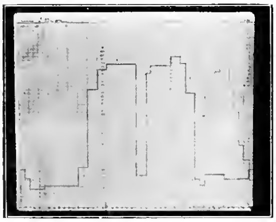
The attendant when taking the reading, every fifteen or thirty minutes as the case may be, records the reading by turning a milled headed nut on the right hand side of the recorder, which moves the pens along a scale to correspond to the amperes. He



must record at the proper time and cannot neglect several or any readings, and then jot them down by guess work and fil in his report.

Referring to Fig. 2, the column of figures on the left are for a D. C. switchboard; they are printed in red ink and the curve is also drawn in red ink. The column on the right is for an A. C. switchboard; these are printed in blue ink and the curve is also in blue ink. The idea is to be able to distinguish the two curves as they may cross or recross each other during the twenty-four hours.

The charts can be printed for other purposes such as to show a voltage curve and an ampere curve, or both for amperes, etc. The figures at the top and bottom of the chart show the time starting at 12 o'clock midnight, until the following 12 o'clock midnight (24 hours). By referring to the chart it is readily seen at any time what the load was on each switchboard. The charts



can be filed and kept for future reference to compare the output of the station for the different days, months or years, etc.

The recorder is provided with a stamp on the left hand side which the attendant operates by pressing a button at any time when the loads have not changed since the last reading, thus showing that he was at his post. The recorder being locked up by the manager or superintendent, the pens carrying at least enough ink to last a week, it will be seen that it is not necessary for the attendant to have access to the recorder only from the outside. It is neatly finished in white nickel, and looks very attractive, mounted with a Seth Thomas eight day clock, and constructed so as not to get out of order. Made by the Martin Automatic Recorder and Register Co., Hamilton, Ont.

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At the request of the city council the city engineer has prepared an estimate of the cost of installing and operating a municipal lighting plant. The figures which he has submitted are as follows: The buildings and plant would cost $950,000, and the cost of installing an arc lighting plant, with a capacity of 1,350 lamps, would be $300,000. If the electric wires were placed underground in the central portion of the city, the cost would be about $510,000. The annual cost of operating the plant with overhead wires would come to about $63 per lamp per annum, or about 17.2 cents per night. Using underground wires, the cost would reach $70 or 19.16 cents per lamp per night.

## ARMOURED CABLE.

Messrs. Jack and Robertson, of Montreal agents for the Sprague Electric Company, New York, have sent us the following in reference to armoured cables :

Our principals in New York, have now turned out a new and modern article, namely Armoured Flexible Cable for Conduit work. The Sprague Electric Company, owning all the patents and equipments of The Interior Conduit & Insulation Company, has, like its predecessor, led the progressive march of improvement in the manufacture of conduit and kindred appliances, and in answer to a persistent demand from some of the leading engineers in this country for further development in the art of electric wiring, is now ready to announce another period in the art-one more mile-stone in the path of progress and a near approach to the highest ideals of those who are mindful only of the interests of electrical developments.

For many years certain engineers have questioned the advantages of a "drawing in" system of interior wiring, involving as it does, two distinct and expensive operations, one being necessary for the installation of the conduit, another for that of the conductors, and base their argument on the fact that considerably less than one tenth of one per cent. of the electric conductors in buildings are subject to disturbance or removal.

With this condition recognized we then have the question—Why must the burden of two installations be imposed on the user of electric current, when only one should be necessary?

Two replies have invariably been ready for this question—First, the absence of definite knowledge regarding the life of insulation. Second, the entire absence of any suitable flexible armour or covering that would protect insulation from mechanical injury. The doubt expressed in the first argument has been removed by time, there being innumerable installations made from ten to fifteen years ago, and in which the wires show a higher insulation resistance to-day, than was obtainable immediately after they were placed in position.

The Sprague Electric Company now replies to the second argument by placing upon the market the Greenfield Flexible Steel Armoured Cable, comprising electric conductors so insulated and braided as to be thoroughly protected from atmospheric influences and armoured so as to defy any mechanical injury incidental to installations in the fire-proof or other buildings of the present day.

Engineers will recognize the advantages of flexible conductors so thoroughly insulated and armoured for use in marine or ship wiring where a rigid conduit system can only be installed at great cost in order to overcome the many obstacles presented by reason of the form of a vessel's structure, the small space available for equipment and fittings, excessively high temperatures, and incessant vibration of the ship.

Factory and mill wiring has hitherto been accomplished chiefly by the use of insulating knobs and cleats, moulding being used in some cases for the larger conductors. Where insulators and cleats are used, as in the majority of such work, the wires, being run from beam to beam, become dust collectors of the best kind, and especially is this the case in cotton and flour mills where the conductors will support an accumulation of lint and fine dust many times exceeding their own size. Perhaps the most costly feature of "open wiring" in such places is the general destruction caused by the breaking or slipping of a belt, which, when once fast caught in the wiring usually brings down several sections, sometimes wrecking or disabling valuable machinery by the operation. These objectionable possibilities are entirely eliminated by the use of "Greenfield Flexible Steel Armoured Cables" and "Cords" which can be firmly secured on the surfaces of the structure wired.

Finished buildings frequently present to the engineer and contractor wiring problems he would prefer to avoid, the alternative being in many cases the practical ruination of handsome, trim and costly decorations or the fishing of conductors without conduit from outlet to outlet, leaving their insulation as legitimate prey for the tools of the mechanic or the teeth of the ever-cheerful and busy rodent, in direct violation of the rules of safe construction. In such buildings "Greenfield Flexible Steel Armoured Cables" can be "fished" from pockets cut at convenient points and may be left with the full knowledge that they are absolutely secure from mechanical or other injury.

New buildings equipped with electrical conductors in accordance with the practice of the present day, require, as before stated, not less than two distinct installations—one of conduits, another of conductors.

The electrical contractor is compelled to make the progress of his work conform to that of other workmen, and is often subjected to costly delays. Alterations from original plans, however necessary or desirable, are in most cases costly in the extreme and sometimes impossible. Under the most favorable conditions, the electric wiring equipment is suggestive of a certain feeling of doubt amounting almost to distrust, and lacks that element of permanence and stability with which it should be associated and to which it is justly entitled.

This Company as the leading conduit manufacturers in the world, might well foster these ideas and practice and cater to them, but in the interests of the public and of the advancement of the art, it seems fitting that we should at this time introduce a new feature in electric wiring, one which at once reduces its cost and places in the front rank of permanent equipments with which the modern building is provided. We feel that this has been accomplished by the development of the "Greenfield Flexible Steel Armoured Cables" for which we ask from architects, electrical engineers and constructors their most favorable consideration.

These flexible products have been fully approved by the Underwriters' National Electric Association.

## SPARKS.

Mr. Laliberte, chairman of the harbor committee of Quebec, has submitted to that body a project for utilizing the power of the tides of the harbor, for the operation of grain elevators and industrial concerns.

The Citizens Electric Company, Limited, of Smiths Falls, Ont., has been incorporated, capital $35,000; president Mr. J.H. Gould, secretary Mr. J. S. Gould. The company are enlarging their works and further developing their power.

The promoters of a number of new pulp mills, for the manufacture of pulp and wood products, to be erected twelve miles above the falls of the St. John river, propose to utilize the power of these falls to generate and transmit electricity to the works.

The annual financial statement of the St. John, N.B., Street Railway Company shows a net profit for the year of $37,792.53, out of which two 3 per cent. dividends were paid amounting to $30,000. The old Board of Directors was re-elected.

A contract has been given by the provincial government, to the Cataract Power Company for the supply of current necessary to light the building and grounds of the asylum for the insane. Provision is made for 1,100 incandescent lights for the building, and 10 arc lights for the grounds, with wiring capacity for 1,500 lights.

The Dominion Government have received an application from Hon. Fred. Peter, formerly Premier of Prince Edward Island, and E. O. Fador, for certain shore rights in the harbor of Vancouver, B. C. They propose to utilize the tides to generate electric power, which will serve Vancouver, New Westminster, etc., and at the same time provide cheaper power.

It is reported that a large number of men are at work on the power development scheme of the Metropolitan company at Britania. It is stated that the construction of the power station will be commenced during the present month. The cofferdam built last year, is being demolished, it having been found to be defective. Another one will be built at the other end of the channel.

Mr. J. P. Graves has made an offer to purchase from the city of Grand Forks, B. C., the water works and electric light plants at the sum of $70,000 and to expend $30,000 additional in improving the system. He also seeks to acquire an exclusive street railway franchise. The ratepayers will be asked to vote on the question. In return for a bonus of $30,000 Mr. Graves offers to provide water works, electric light, and trolley systems for the city of Columbia.

## MOONLIGHT SCHEDULE FOR JULY.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H. M. | H. M. | H. M. |
| 1.... | P.M. 9.00 | A.M. 3.30 | 6.30 |
| 2.... | " 9.30 | " 3.30 | 6.00 |
| 3.... | " 9.50 | " 3.30 | 5.40 |
| 4.... | " 10.20 | " 3.30 | 5.10 |
| 5.... | " 10.50 | " 3.30 | 4.40 |
| 6.... | " 11.20 | " 3.30 | 4.10 |
| 7.... | A.M. 0.00 | " 3.40 | 3.40 |
| 9.... | " 0.40 | " 3.40 | 3.00 |
| 10.... | " 1.30 | " 3.40 | 2.10 |
| 11.... | No Light. | No Light. | .... |
| 12.... | No Light. | No Light. | ..... |
| 13.... | No Light. | No Light. | ..... |
| 14.... | No Light. | No Light. | ..... |
| 15.... | P.M. 8.00 | P.M. 10.30 | 2.30 |
| 16.... | " 8.00 | " 11.00 | 3.00 |
| 17 ... | " 8.00 | " 11.30 | 3.30 |
| 18.... | " 8.00 | " 11.45 | 3.45 |
| 19 ... | " 8.00 | A.M. 1.00 | 5.00 |
| 20.. . | " 8.00 | " 1.30 | 5.30 |
| 21.... | " 8.00 | " 2.10 | 6.10 |
| 22.... | " 8.00 | " 3.00 | 7.00 |
| 23.... | " 8.00 | " 3.50 | 7.50 |
| 24.... | " 8.00 | " 3.50 | 7.50 |
| 25.... | " 8.00 | " 3.50 | 7.50 |
| 26.... | " 7.50 | " 3.50 | 8.00 |
| 27.... | " 7.50 | " 3.50 | 8.00 |
| 28.... | " 7.50 | " 3.50 | 8.00 |
| 29.... | " 7.50 | " 3.50 | 8.00 |
| 30.... | " 7.50 | " 3.50 | 8.00 |
| 31.... | " 8.20 | " 3.50 | 7.30 |
| | | Total......... | 148.25 |

## TRADE NOTES.

The Anchor Knitting Co., Almonte, Ont., are installing a 10 k. w. multi-polar direct current generator, supplied by the Royal Electric Co., to light their factory.

The Granby Consolidated Mining & Smelting Co., Grand Forks, B. C., is installing a 10 k. w. multi-polar direct current generator purchased from the Royal Electric Co.

The Shawinigan Water & Power Co., Shawinigan, Que., is installing a 150 k. w. "S. K. C." two-phase inductor generator purchased from the Royal Electric Company.

Mr. Clayton, manager of the Central Electric Co., of Portage La Prairie, while on a trip through the East a few days ago placed an order with the Royal Electric Co. of Montreal for one of their 150 k. w. "S. K. C." two-phase generators.

The Penetang & Midland Street Railway Light aud Power Company, Penetang, Ont., has greatly increased its incandescent lighting business and has purchased a 150 k. w. "S. K. C." two-phase generator, complete with exciter and switchboard from the Royal Electric Company.

The Brantford Electric & Operating Co., Brantford, Ont., who have been furnishing arc and incandescent lights and operating motors from a 180 k. w. "S. K. C." successfully for the past four years are largely increasing their power and lighting business and have ordered from the Royal Electric Co., a 360 k. w. "S. K. C." two-phase machine.

## SPARKS.

It is reported that an American firm of manufacturers of electrical machinery and supplies are considering the advisability of establishing a branch factory in Ottawa.

Representatives of a number of Street Railway Companies in Ontario met in Toronto recently and arranged for circuit entertainments to be given in the parks owned by the companies.

The employees of the British Columbia Electric Railway Company held their annual picnic on June 13th, in Queens Park, New Westminster. A good programme of athletic sports was provided.

Robt. C. Trouax, electrician for the Thousand Island Park Association, was killed by an electric shock on June 23rd. It is thought that while closing the circuit his hand touched the contact bar.

Extensive improvements are being made to the Bell Telephone Company's system at Winnipeg, and communication is being established with Portage La Prairie and a number of other outside towns.

It is said to be the intention of the Ontario Power Company to begin the construction of development works this summer. The company claim to have received applications for 30,000 horse power.

Work was recently commenced on the long distance telephone line, between Winnipeg and Brandon, via Portage La Prarie. The line is already completed to a point sixteen miles west of Winnipeg.

Niagara Falls are to be illuminated by electricity during the coming Buffalo Exposition. By means of searchlights placed on both sides of the river, the colours of the lights which are thrown on the Falls will be constantly changed. Arc lights will also be placed in the Cave of the Winds, which will give to the water which falls in front of it a phosphorescent effect.

Work will shortly be commenced on the construction of a new power house for the Ottawa Street Railway Company. It will be a duplicate of the present power house, will be entirely fireproof, and will cost, including water wheels and plant, about $150,000. The plant will include a 2,000 horse power generator, now being manufactured by the Westinghouse Co., at Pittsburg, and four large water wheels.

Mr. J. G. Macklin, of the Royal Electric Co., Montreal, has prepared plans and data at the request of the Renfrew Power Company, for the utilization of the power of the Bonnechere river. Mr. Macklin estimates that when the water is lowest, 728 horse power can be obtained, and at high water 1,500 horse power. The estimated cost of the development of this power is $40,000. The company is now applying for a charter and has elected the following provisional directors :—Messrs. A. Barnet, P. S. Stewart, John Ferguson, M. P., W. A. Mackay, Dr. Murphy and Thos. A. Low.

Some time ago the council of Winnipeg gave notice of its intention to discontinue its arrangement with the Bell Telephone Company, under which the company operated the city fire alarm system. Quite recently the mayor requested the company to continue the operation of the system for a few months longer until the city could complete arrangements for taking it over. In reply the company stated that having made arrangements to occupy the space used by the fire alarm instruments, they were not in a position to accede to this request, but would be willing to renew the contract for a further period of three years. To this proposal the city would not consent, and thus the matter stands.

The annual meeting of shareholders of the Canadian Electric Light Company was held at Quebec on June 26th. The annual report of the directors, submitted at this meeting, showed that the development works are well advanced and will probably be completed by the end of September. Contracts have already been made for 3,000 lights, and it is expected that operations will be commenced with a lighting load of 5,000 to 6,000 lights. Negotiations are in progress and are proceeding satisfactorily, for lighting the streets of the town of Levis. Applications have also been received for power from several manufacturing concerns. Tenders have been received for the laying of a sub-marine cable to carry current from Levis to Quebec, and the right has also been secured from the Quebec Bridge Company to use their bridge for the like purpose. The shareholders will be asked to authorize the issue of additional stock or debentures to complete the works. The probable revenue for the first year is estimated at $25,000, and the operating expenses at $1,000 per month.

## SPARKS.

While repairing the fire alarm system Edward J. Tremblay, a lineman in the employ of the city of Hull, came in contact with the Hull Electric Company's wires charged with 2,000 volts, and was instantly killed.

A company is being organized at Ottawa to manufacture a new form of gas, which is said to be composed of 93 per cent. of air and 7 per cent. of illuminating mixture. The process of manufacture is thus described: An electric motor worked automatically at intervals during an hour, collects a certain amount of air into a blower. The air then goes into a chamber containing acid, and passes from there into a place containing carbonators. The acid chamber robs the air of carbon, and when the air goes into the carbonators it is practically pure oxygen and non-poisonous. In the chamber containing the carbonators there are wicks saturated with the illuminating mixture which is supplied from a receptable attached to the apparatus. The atmosphere in passing into the carbonators is combined with 7 per cent. of the illuminating mixture. The gas finally goes into the chamber from which it may be used. As the gas becomes exhausted in the tank out of which it is drawn for light, an automotic arrangement causes the electric motor to work and send in more air. The electric motor, beyond sending in the air, has no connection with the gas making machine. In fact, a system of weights could be used instead of a motor. The light produced is said to be pure white and 7 times stronger in illuminating power than a 16-candle electric light. The cost of production is said to be only $100 for 250 lights. The gas is employed for heating as well as for lighting. Messrs. J. R. Booth, J. A. Saybolt, and Capt. C. Foxwell are said to have secured control of the process of manufacture for Canada

## SPARKS.

Messrs. Wm. Moore & Sons, Meaford, Ont., have purchased a 1000 light alternator from the Royal Electric Co.

The Penetanguishene Electric Light Company have contracted with the Royal Electric Company, of Montreal, for a new 3,000 light dynamo.

Mr. Thos. Low, of Renfrew, Ont., is forming a company to develop the water power of the Bonnechere river. It is intended to spend about $40,000.

By the explosion of a boiler in the Dominion Iron & Steel Company's quarries at Sydney, C.B., the engineer, Mr. Perry, of Londonderry, was killed.

The town of Hespeler, Ont., will submit a by-law to the ratepayers to provide $10,000 for the purpose of taking over the electric light plant of Mr. Shantz.

By coming in contact with a live wire in the power house of the Lindsay Light, Heat & Power Company, at Fenelon Falls, Ont., engineer Poole was instantly killed.

The ratepayers of Bracebridge, Ont., will vote on a by-law on July 16th to raise $6000 by the issue of debentures for the purpose of developing power for the generation of electricity.

The Ottawa Electric Company has just awarded a contract to the Stillwell-Bierce and Smith-Vaile Company of Dayton, Ohio, for water-wheels for their new electric light station.

The Brantford Electric & Operating Company have just decided to build a new power house. All the machinery will be raised 10 feet above the highest flood level known. The estimated cost of the proposed improvements is $30,000.

A piece of steel was successfully removed from the eye of one of the employees of the Canada Atlantic Railway, by means of a magnet in the office of the Ottawa Electric Company.

Col. Tracey, City Engineer of Vancouver, B.C., has reported for the corporation of Revelstoke, B. C., as to the value of the Revelstoke Company's plant, which will probably be taken over by the town.

The Bowmanville Electric Light Co., Bowmanville, Ont., has been compelled, by a large increase in its business, to purchase new machinery, and has ordered from the Royal Electric Co. a 90 k. w. two-phase "S K. C." inductor alternator.

Mr. Matthew Neilson, C. E., of Almonte, manager of the St. John, N. B., electric railway, has recently returned from Jamaica, where he was engaged for several months in superintending the construction of an electric railway for his company.

No further action has been taken by the Ottawa city council towards granting a renewal contract to the Ottawa Electric Company, and on the other hand no steps have been taken by the company in the direction of negotiating with the city for the sale of its plant.

Joseph Geddes, an electrician in the employ of the Chambers Electric Light & Power Company at Truro, N. S., recently came in contact with a live wire while working with an arc light. He was severely burned on the head and hands, but recovered from the shock.

A scheme is said to have been decided upon by the interested concerns for improving the Chaudiere water power at Ottawa. It is understood that all obstructions will be removed and the intakes enlarged, and that the work will cost about $50,000. The The Ottawa Electric Company, McKay Milling Company, J. R. Booth, and others are interested.

Contracts have been awarded for the erection of a handsome new building in Montreal to serve as the headquarters of the Canadian Pacific Telegraph Company. The new building will be erected on the site of the old one which is now being torn down. It will have a frontage of 100 feet on Hospital street, 45 feet on St. Francois-Xavier street, and 51 feet on Exchange Court. It will consist of eight stories, the lower stories to be constructed of New Brunswick sandstone, and the upper stories of mottled pressed brick. Modern skeleton steel construction will be employed, and the structure will be made fire-proof throughout. The operating room will be located on the eighth storey with an entrance on the corner of Hospital and St. Francois-Xavier street, and a second entrance on the last named street for employees and messengers. The ground floor will be occupied by the Company's offices. The main entrance will be on Hospital street.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. X. AUGUST, 1900 No. 8.

# Canadian Electrical Association Convention

## KINGSTON THE MEETING PLACE

THE great conflagration which occurred in the cities of Ottawa and Hull a few months ago has been responsible for the selection of the city of Kingston as the meeting place of the tenth annual convention of the Canadian Electrical Association, likewise for a change in the date thereof to August 29th, 30th and 31st. These changes, however, are not likely to affect in the slightest degree the success of the convention, which gives promise of being well attended and of an interesting character. A new departure will be an exhibit of electrical apparatus. It is understood that a number of the manufacturing and supply firms are expected to exhibit, and a unique and attractive display may be looked for. Among the social features will be the usual banquet, excursions, and a military tattoo. The business of the convention will close at noon of Friday, 31st inst. Illustrations and particulars of some of the electrical and other features in and around the city of Kingston, together with the programme of business and social features, will be found on this and following pages.

CONVENTION HEADQUARTERS—CITY HALL, KINGSTON.

### THE CITY OF KINGSTON.

Briefly sketching the history of this city, which will be pleased to entertain the members of the Canadian Electrical Association; Kingston under the name of Fort Cataraqui was established by the French, under Governor de Courcelles (1672) as a fur trading post. Count Frontenac's strong rule produced the massive stone fort called after himself. Ultimately seized and occupied by both the French and English, it was destroyed by the latter under Colonel Bradstreet in 1878. Rebuilt as Fort Henry, that historical structure still frowns upon all enemies to the city. The seat of government in 1841, Kingston grew in importance.

The general appearance of the city is that of solidity and antique beauty. Extensive industries of shipbuilding, grain transhipment and the weaving of cotton and woollen goods are carried on. In connection with the latter two, and numerous other local industries, electricity is used as the lighting, and largely as the power medium.

On entering the harbor of Kingston, the "Sandhurst" or west point of Canada, one is struck with the beautiful natural situation of the city. Nestling at the foot of Lake Ontario, at the head of the St. Lawrence, and at the mouth of the Rideau canal, it has a splendid situation and an excellent harbor. To the west stretches the village of Portsmouth, distinguished for its shipbuilding and trans-shipping industries, where are also the Rockwood Asylum and the Kingston Penitentiary. Fronting the city are the military college, the massive grey stone masonry of Fort Henry, numerous martello towers—objects now of historical interest. Imposing public buildings, churches, and artistically designed private dwellings, all display the prevalent limestone architecture which has secured for this military town the name of the "Limestone City." Kingston is well laid out and adorned by massive buildings.

Visitors should not fail to see the city hall, one of the oldest but at the same time best designed municipal buildings in Canada, the court house with its pillars and dome in Grecian style, the post office, custom house, St. Mary's cathedral—the tower of which, situated in the heart of the city and a masterly work of

Gothic architectural skill, can be seen at a great distance. St. George's cathedral, recently rebuilt and decorated in the interior with a magnificence of design and finish, unrivalled before in the history of local architecture, will well repay a visit. In the artificial lighting of the interior of this church, Mr. I. H. Breck, the Princess street electrician, displayed great skill and judgment. Delegates visiting the church will not fail to admire the elegance of design in the fixtures and the specially designed corrugated reflectors in the altar. The high shapely dome is supplied with 54 lights of the Edison base and 16 candle power. Shades are set in porcelain. The switchboard, of polished white marble, has eight separate switches. The fixtures and controlling power of the 150 lights are considered to be the best work in electrical illumination yet done in the city.

Kingston's colleges are of continental repute. They are Queen's University, Royal Military College, Royal Medical College, School of Art, Business College, Congregation de Notre Dame, etc. Each of these, the magnificently equipped General Hospital and Hotel Dieu, and the public school building are well worth a visit. All the institutions named have all modern conveniences of electricity, such as lighting, communication and heating.

Running in a northerly direction are Princess, Brock, and, slightly more to the east, Barrie streets, while King and Ontario streets stretch parallel to the water front and from east to west.

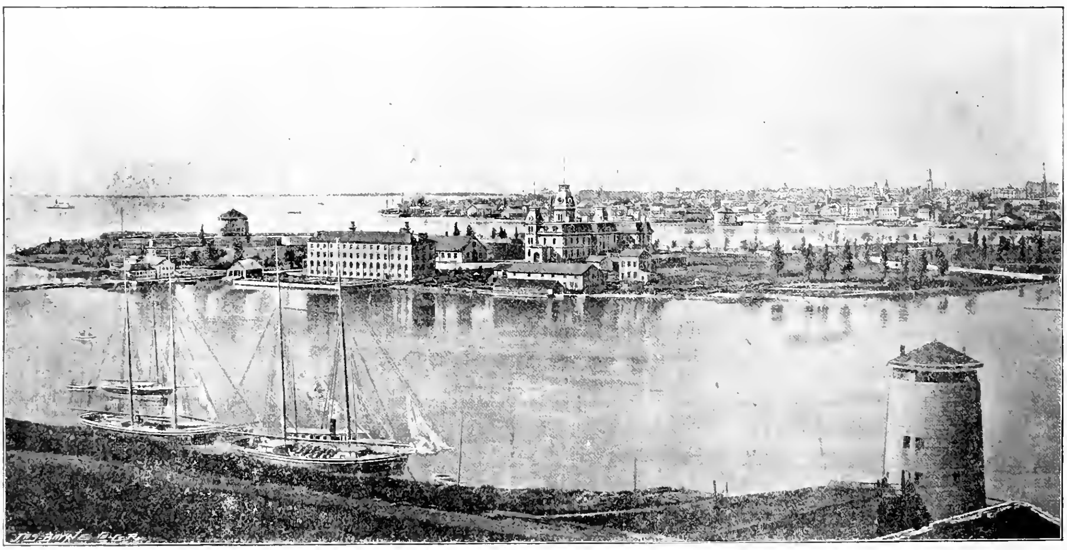
The city buildings, where the coming convention will be held, overlook the harbor, command a splendid view of Fort Henry and Barriefield, and are within a few yards of both the Grand Trunk and the Kingston & Pembroke Railway depots.

THE COURT HOUSE.

In architecture the Court House most resembles the City Hall, and built of limestone it has the same large front pillars, the same massive proportions, and is about of the same dimensions. In the building are the court rooms, county council chambers and offices, judges' chambers, sheriff's offices, etc. On an elevation, the building commands a fine view of the cricket field, city park, and some very handsome residences. It is in front of this building that the Sir George A. Kirkpatrick memorial fountain will be placed. Street cars pass close by, so every delegate should see the building.

SOME PLACES OF BUSINESS.

The three storey building of the wholesale dry goods firm of Macnee & Minnes is one of the largest, finest, and handsomest stores in Kingston. Made of solid stone, the massive structure is the most conspicuous in the city. The business is over half a century old, and its age is exceeded by its solidity and sound financial basis. The firm exports wholesale every description of dry goods to all parts of the world. Mayor Minnes is a member of the firm. On the corner of Bagot and Princess streets the building presents a most imposing appearance. The delegates will receive a hearty welcome from the proprietors and staff of fifty hands. This old wholesale establishments, one of the city's landmarks, is well worth a call.



THE CITY OF KINGSTON.

Wormwith & Co. is one of the oldest, most noted and prominent firms in the piano industry, which has for a third of a century enjoyed the highest reputation. The business was established in 1862, and the firm soon became known as makers of distinction, and almost from the start their instruments have been regarded as among the most reliable made. Their present factory is situated on the corner of Princess and Ontario streets, and is one of largest buildings in the city, it being 166 by 66 feet, of cut stone, four storeys and basement, with a 60 by 60 foot building in the rear, and is among the most extensive and best equipped factories in the Dominion, having a capacity for turning out 900 pianos per year. Formerly the firm used electric motors, but increase of business has demanded the use of steam for motive power.

THE MAYOR OF KINGSTON.

In this number will be found a portrait of Mayor Minnes, who has served four years as alderman and is

now chief magistrate of the city. Connected with Macnee & Minnes, wholesale dry goods firm, he and his father before him have long been identified with the soundest and most substantial business enterprises of the city. Although only 31 years of age, Mr. Minnes is a friend of all and an idol with the laboring classes. The friendly interest that he takes in all the city's functions, be it a fair, a celebration, or a convention, is now being exerted to entertain in a fitting manner the Canadian Electrical Association delegates.

THE FIRE BRIGADE.

Chief Youlden, assistant chief Elmer, and engineer Miller, with the other thirteen men of the fire brigade, will be glad to show the delegates around the two well equipped city stations. With all modern appliances, 3,200 feet of hose and a system of alarm including 26 boxes, most of them made by Anderson, of Toronto, the brigade does first-class work. In connection with the alarm system 15 miles of galvanized wire (fast giving place to the more modern and enduring covered wire), are Manual switchboards, one in the Ontario street, and one in the Brock street stations. Four mechanical and eight electrical gongs are placed in the stations, firemen's homes, police headquarters, etc. The system is run by by a 102 cup gravity battery. Electrical devices as to alarms, closing doors, etc., are in vogue in both fire stations. Anderson, of Toronto, laid a large part of the system. The Bell Telephone Co., Montreal, turned out four of the alarm boxes. The Dominion Government has an arrangement with the Department as to protection of the Royal Military College.

THE RAILWAY STATIONS.

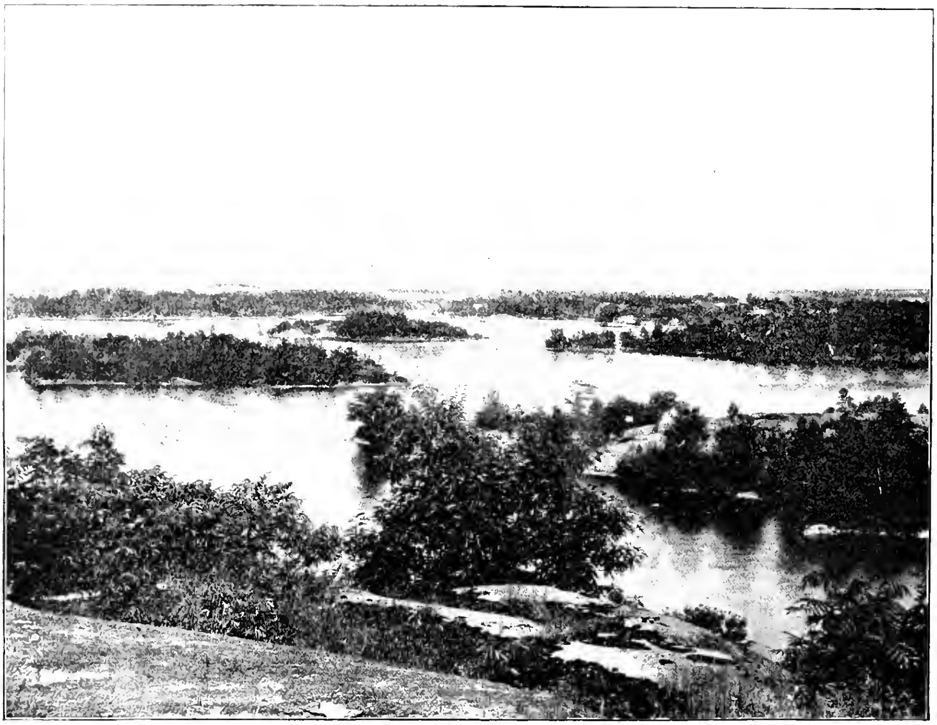
In front of the city hall is situated the Kingston and Pembroke Railway station. The handsome building, 65 x 24 feet, built of cut limestone, coursed ashlar style, is two storys high. It has a mansard roof covered with slate, and is ornamented with pretty iron designs. Finished in natural woods, with plate glass windows, and transoms of beautifully colored glass, and containing offices, waiting rooms, lavatory and electric lights, the interior is handsome in appearance. The building cost $12,000. In the rear of the station is the two story freight shed, 100 x 34 feet. It is constructed of wood and iron, orial windows projecting from the upper story. Electric lights, appliances, gongs, a telegraphic plant, offices, and a library for employees, are some of the features. The cost was $6,000.

KINGSTON HARBOR AND PART OF THE CITY FROM THE TOP OF ONE OF THE GRAIN ELEVATORS.

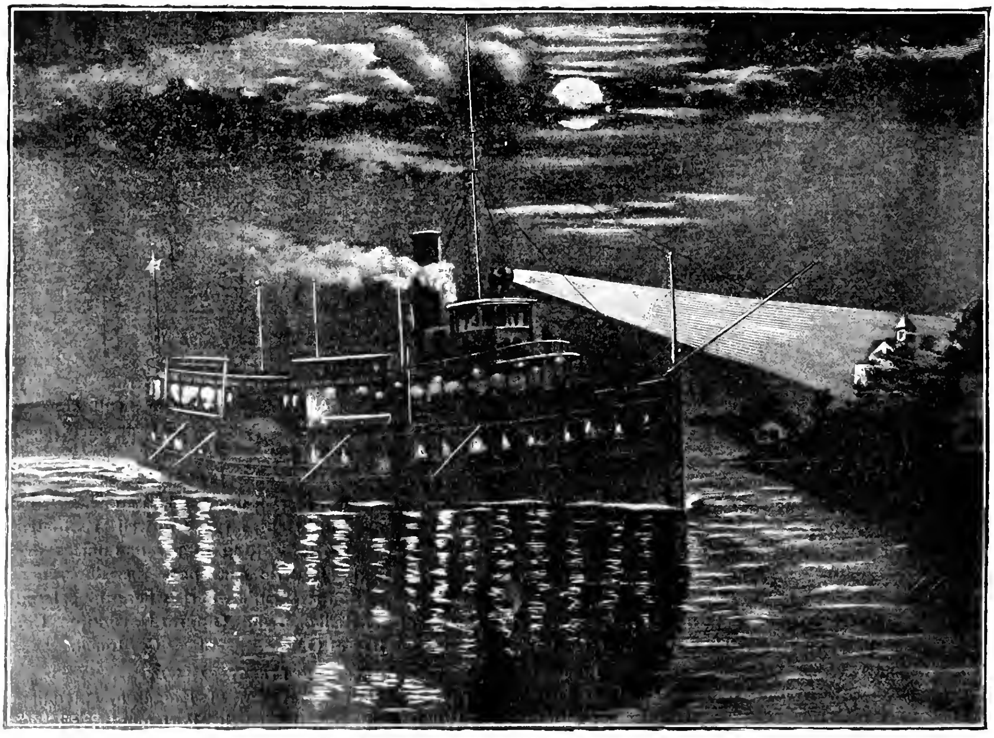
The G. T. R. outer station, two miles from the city is a one story building, thoroughly equipped with offices, waiting rooms, electrical devices, telephone and telegraphic communication, etc. The city depot at the foot of Johnston street, and a few minutes walk from the Hotel Frontenac, is built of brick and stone. It is a two story building, bright, large, and well ventilated and illuminated. The waiting rooms and offices are neatly furnished. Electric cars pass the door, and opposite the station is Swift's wharf where the palatial steamers of the Richelieu and Ontario Navigation Co. and also the Bay of Quinte Steamboat Co. touch.

ELECTRIC STREET RAILWAY.

The street railway system of Kingston, extending to Williamsville on the north, Portsmouth, passing directly in front of the asylum and penitentiary, on the east, and a branch line connecting with the G. T. R.



A View from Smoke Island, in Canadian Channel on the New "Island Wanderer.



Steamer St. Lawrence on Her Searchlight Excursion Among the Thousand Islands.

depot on the west, is one of the most modernly equipped in Canada. The company has a capital stock of $200,000. The road is well laid out over 12 miles with a 4 ft. 8½ in. gauge track, made of "T" rails, 55 to 65 lbs. to the yard. The current is supplied by the Kingston Light, Heat & Power Company from the power house on Queen street to the 19 handsome motor cars of modern upholstery and furnishing.

Skirting the lake front, the eastern portion of the line passes several city parks, many handsome private dwellings, churches, public schools, etc., on King, Ontario, Barrie and Union streets; and running for two miles passes Portsmouth to enter Lake Ontario park, Kingston's "Hanlan's Point," where 40 acres fronting the lake front have been converted into an ideal park, with horse track, diamond, bicycle track, etc., in connection and in the best of condition. The asylum and penitentiary nearby are interesting places the delegates will be requested to visit.

The other two branches—the belt line and that running two miles out to the depot—pass some fine buildings, parks, and natural scenery, which Kingstonians claim are unrivalled.

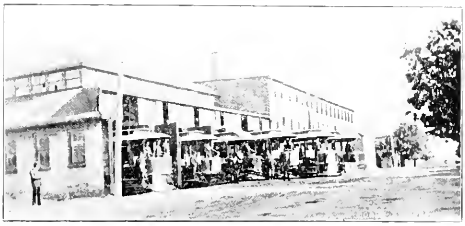
The officers of the company are: Ira A. Breck, president; B.W. Folger, vice-president and manager; J.W. Bowden, secretary; H. C. Nickle, superintendent; J. Halliday, electrician. One of the views shown gives a good picture of the street cars, showing six of them leaving the car barns on King street at 7 o'clock in the morning.

Kingston Penitentiary.

ELECTRICAL PLANT AT THE PENITENTIARY.

No doubt all the delegates will make it a point to visit the penitentiary, where upwards of 600 prisoners are confined, amongst the number the celebrated trio of dynamiters, Walsh, Nolan and Dullman, whom the government are so zealously guarding. The penitentiary has an electrical plant, built by W. A. Johnston, of Toronto, consisting of two 250 light Ball machines. The offices, avenues, guards' quarters, etc., in the big enclosure are all supplied with lights, and one incandescent is placed in each prisoner's cell. Fronting the huge main gateway, near the observation towers, and in the interior yard, are several powerful arc lights, all lit up every night. Electrical communication, bells, gongs, etc., are in vogue through all parts of the prison. The current is carried to the opposite side of the road to light up the interior and grounds of Warden Platt's palatial residence and magnificent grounds. Wm. Derry is chief engineer, and Charles Bailey electrician.

At Rockwood Asylum a small Edison bi-polar machine supplies 60 lights to illuminate the music hall. The matter of installing a large and modern plant to light the whole building is under consideration. The street cars pass both penitentiary and asylum.

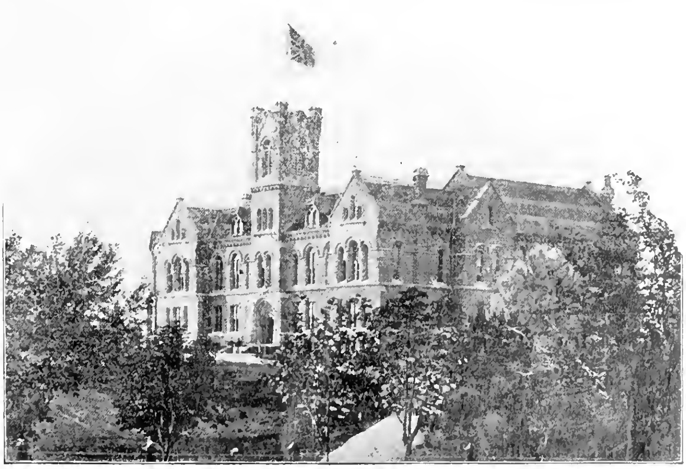


Car Barns of the Kingston, Pembroke and Cataraqui Electric Railway Company.

ELECTRICITY IN QUEEN'S UNIVERSITY.

At Queen's University the current is supplied to the general buildings by the Kingston Light, Heat & Power Co. It is used in running two motors in the mechanical laboratory for the purpose of driving the various pieces of machinery, and one motor in the Carruthers Science Hall for purposes of ventilation, in decomposing water for the purpose of obtaining oxygen and hydrogen for the chemical laboratories, in exciting electro-magnets in the magnetic separator in the mining mill, and in running a number of electric lanterns, of which there is one in connection with nearly every department, and as the alternating current is not adapted to lantern work, on account of its objectionable singing, the direct current is the only one employed.

Preparations are at present being made for a very much more extended use of electricity than at present; for in addition to the present use it is proposed to intro-



Queen's University, Kingston.

duce a complete system of fan ventilation in each building, both old and new, and to drive the fans of each building by separate motors.

In connection with this the university will erect a central heating and power station within its own grounds, from which heat, power and light will be distributed to the buildings as required. It will be feasible then to light not only the buildings, but also the campus by electricity when required. To accomplish all this a considerable number of dynamos and motors, as well as other electrical appliances, will be required. And as Queen's, although well grounded in the public confidence, has no liberal millionaire at her back, she has to go slowly, much more slowly than her progressive spirit desires, and she will always be thankful for any aid extended to her in carrying out her proposed and much required extensions and improvements. Prof. N. F. Dupius, one of the best known mathematicians in America, has long been Dean of the Faculty of Practical Science at Queen's.

MR. M. H. FOLGER,
President Thousand Island Steamboat Co.

MR. F. A. FOLGER, SR.
Manager Kingston Light, Heat and Power Co.

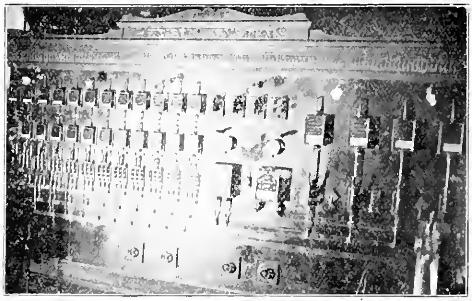
MR. B. W. FOLGER, SR.
Manager K.P. and C. Electric Railway Co.

KINGSTON LIGHT, HEAT AND POWER COMPANY

The Kingston Light, Heat & Power Company's plant is located on the corner of King and Queen streets. The power house is of stone and brick, 40 feet by 80 feet, with boiler room 32 by 49 feet. The water supply for the condensers and boilers is taken from the foot of Queen street, which is about 300 feet distant. In the boiler room are five tubular boilers 66 inches by 14 feet, with 106 three inch tubes each, one upright engine and fan outfit for forced draught, and one duplex pump for hoisting elevator, &c. The fan outfit is used very seldom, as a well constructed brick chimney 5 feet in diameter by 60 feet high supplies ample draught. Two tons of hard to one of soft coal screenings are used for fuel.

In the engine and dynamo room are two tandem compound condensing Corliss engines of 350 horse power each, built by Messrs. John Inglis & Son, Toronto; one Northey condenser and one Northey tandem compound feed pump for supplying the boilers; one upright brass tubular heater made by the Kingston Foundry Company. The engines are belted direct to a main line shaft, from which are driven two No. 20 Edison dynamos coupled up for the Edison three wire system for central distribution; one No. 60 T & H 2,000 volt alternator for the long distance lighting; three 50 light American arc machines for supplying street lighting; one 200 k.w. 500 volt multipolar street railway generator, manufactured by the Canadian General Electric Company, and one 100 k.w. 500 volt multipolar street railway generator manufactured by the same company. Power is supplied from these machines for the operation of the street railway system. In the front of the building is one of the best equipped switch-boards in Canada, made of slate slabs one inch thick by 5 feet square. It stands 10 feet high by 23 feet long, with all the necessary instruments that are required to duplicate the generating plant, which was the original design of the plant.

POWER HOUSE, KINGSTON LIGHT, HEAT & POWER CO.



SWITCHBOARD, KINGSTON LIGHT, HEAT & POWER CO.

The plant is now at times taxed to its full capacity, and the company are preparing for extensions to meet

the fall business. There are 8,000 sixteen candle power lights installed and 115 arc lamps for street lighting.

Annexed to this building is the gas plant, which has just gone through a renovation and is now one of the most up to date plants in Canada. The electric light and gas business are one of the many lines of business which Messrs. Folger Brothers are interested in, and is under the management of Mr. F. A. Folger, sr.; secretary and treasurer, E. Moore; superintendent of electrical department, F. Simmons.

Mr. JAS. A. MINNES, Mayor of Kingston.

THE BELL TELEPHONE EXCHANGE.

Amongst other places of interest to the delegates attending the Convention at Kingston, the exchange of the Bell Telephone Company will be visited with pleasure.

Like other branches of the art, telephony has been brought to such perfection that one hardly recognizes in the modern exchange any signs of the business having once been crude, irritating and unsatisfactory.

Kingston is a fair sample of the progress made during the past twenty years. This exchange was started in 1880 with about thirty subscribers; most of the lines were on house-tops, and "Gilleland" switches were the standard equipment of that day. There were no long distance lines. The growth was very slow, only reaching 175 subscribers in 1885. Since that date three complete changes in switching equipment have been made, long distance lines have been built, and Kingston is to-day one of the most progressive telephone cities in Canada. The local subscribers number 540, while the splendid service furnished has induced merchants and the management of large marine interests to liberally patronize the long distance lines. The exchange is a model for convenience and up-to-date equipment. The operating room has been specially designed for perfect light, ventilation and convenience. The distributing arrangements, arresters, power generators, etc., are of the most modern type, and everything about the place has an unmistakable business air about it.

The exchange has since 1885 been in charge of Mr. A. T. Smith, now district superintendent of the Ontario department, with headquarters at Toronto, whose thorough knowledge of the details of the business is well known to the members of the Association. He has been succeeded by Mr. H. W. Snelling, of Montreal, who reports business as flourishing and repudiates that old "chestnut" that Kingston is "slow."

A visit to the exchange, where all are welcome, will well repay the delegates.

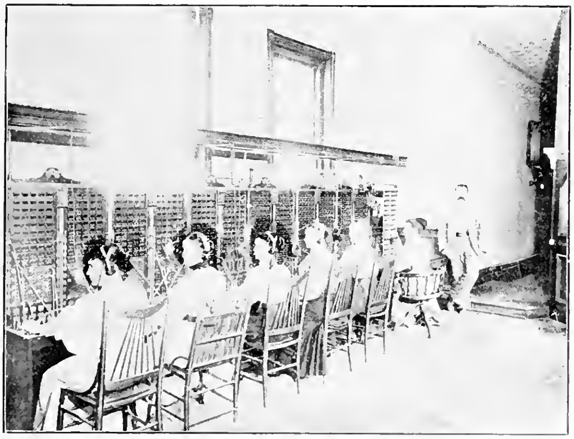
FURNISHED WITH ELECTRIC PLANTS.

The Montreal Transportation Company's mammoth elevator at the foot of Barrack street is well worth a visit. The plant is equipped with a 250 light multipolar dynamo of the Canadian General Electric Company's type, which is directly coupled to an Ideal engine. Numerous powerful arc lights, some of them movable, illuminate the surroundings very brightly and make the loading and unloading of thousands of bushels of grain at night time an easy matter. This company frequently trans-ships as much as 250,000 bushels of grain in 24 hours.

The Kingston Hosiery Company is another industry that has a plant of its own. It is equipped with a 500 light multipolar Walker type dynamo, manufactured by the United Electric Company, of Toronto, and coupled to an Robb-Armstrong engine. Knitting machines, etc., are driven by motive power.

The Royal Military College has a small plant furnished with all the necessary appliances that are required for technical purposes, and for instruction in classes in connection with military engineering, electrical engineering, etc.

The Dominion Cotton Company last spring installed in their local mill an excellent plant, including one 650 dynamo made by Siemens & Halske. The current is direct from a coupled dynamo. The engine is a Robb one. The plant was installed by the Royal Electric Company, of Montreal.



INTERIOR OF BELL TELEPHONE EXCHANGE, KINGSTON.

ELECTRIC SEARCH LIGHTS.

Kingston is surrounded with the elements of the beautiful. From the "Limestone City" to Brockville the scenery is most magnificent. Between the points mentioned seventeen hundred isles — the renowned thousand islands — all sizes, from a barren rock to large islands covered with the richest foliage, and containing some of

their palatial summer residences, rise from the bosom of the St. Lawrence. The well equipped steamers of the White squadron thread their way through the labyrinthian channels, disclosing little islets, isles, artificial devices, etc., of the most delicate and varied type of loveliness. It will be the privilege of the delegates to view some of these islands under the searching beams of

MR. I. A. BRECK,
President Kingston, Pembroke and Cataraqui Electric Railway Company.

the powerful searchlights of one of the steamers referred to. This line of boats, conducted by the Folger Bros., are all equipped with electric plants. The electrical plants of the steamers St. Lawrence and Empire State each consist of a Westinghouse engine, C and C dynamos of 500 lights capacity, and searchlights made by the General Electric Company, Schnectady, and of 2,000,000 candle power. The steamer America has an Edison dynamo of 500 lights capacity, and searchlight of 2,000,000 candle power made by the United Electric

MR. W. F. SIMMONS,
Superintendent Kingston Light, Heat & Power Company.

Company, of Toronto. The New Island Wonder, the New York, the Hero, and other steamers, all have powerful searchlights and are beautifully illuminated with incandescent lights. The searchlight trip down the River St. Lawrence is something no delegate should miss. On the return trip the steamer will pass near Wolfe Island, Garden Island, and all along the harbor front, which the powerful searchlight will illuminate brilliantly.

CITY ELECTRICIANS.

A word might be said regarding those engaged in the electrical business. Mr. W. F. Simmons commenced his electrical career in 1888 as errand boy with the then Kingston Electric Light Company. By his close observation he was soon promoted to engineer and dynamo tender, under the superintendence of Mr. J. M. Campbell. In a very short time the company found it necessary to enlarge their plant and add an incandescent plant. At this change Mr. Simmons was promoted to foreman of construction. This position he held until the amalgamation of the electric light and gas companies in 1890, under the name of the Kingston Light, Heat & Power Company. At this stage Mr J.

MR. J. HALLIDAY,
Electrician Kingston, Pembroke and Cataraqui Electric Railway.

M. Campbell resigned to accept a position with the Canadian General Electric Company as electrical engineer, and Mr. Simmons was advanced to the position of superintendent. This position he has held for ten years, and has certainly proved to be a thoroughly practical electrical and steam engineer.

Mr. I. H. Breck commenced business in 1897 at 339 King street. He remained here until the year 1899, when he found it necessary, owing to increased business, to move to the large and commodious store that he

MR. HUGH C. NICKLE,
Superintendent Kingston, Pembroke and Cataraqui Electric Railway.

now occupies. In his place of business, 79 Princess street, will be found everything of interest to an electrician, all of the latest things in the electrical lines, etc., for being an electrician himself he knows exactly what and where to buy. His workmen are skilled electricians who have spent years at their trade, and the several large buildings he has wired speaks well of his ability and serves to show that he is competent to undertake any work entrusted to him. His work in St. George's Cathedral, at Kingston, is a good

example of his workmanship. He makes a specialty of all kinds of electric wiring and motor work, and has full and complete facilities for testing and repairing. Mr. Breck learned his trade with the Kingston Light, Heat & Power Co., and studied the several branches of the work there, and has now a thorough knowledge of the electrical business. Mr. Breck's men are under the supervision of Mr. W. S. Raymond, who is an expert electrician.

Mr. R. Boyd, electrician, at his store, 327 Princess street, keeps always on hand dynamos, motors, annunciators, gongs, bell wire, electric lights, etc. He also learned the business with the Kingston Light, Heat & Power Co., and has met with considerable success. He makes a specialty of window electric wiring and illuminating.

Mr. George R. Tomlinson keeps a supply of all kinds of electrical goods at his well equipped store at 258 Princess street. He makes a specialty of window illuminations.

NOTES ON THE CONVENTION.

Mr. I. H. Breck will have constructed over the platform in letters of incandescent lights the words "Welcome C. E. A." They will be set on a background designed as a maple leaf, emblematic of the Association, and will be brilliantly illuminated with colored lights.

In connection with the proposed exhibit of electrical apparatus, it is learned that the Packard Electric Company, of St. Catharines, have secured 900 square feet of space, that the Royal Electric Company will make an exhibit, and that the Western Electric Co., of Chicago, and the Adams-Bagnall Co., of Cleveland, will each make a display of enclosed arc lamps.

Kingston owns its waterworks, the pump house being on Ontario street near convention headquarters. All delegates should inspect it, as the system is an excellent one, and most of it but lately built.

The delegates will mostly register at the Hotel Frontenac, the largest and best equipped in the city. The genial proprietor, Mr. Thomas Crate, so well known to the travelling public as a first-class hotel keeper, will look well after the wants of the members of the Association. The "Frontenac" is on Ontario

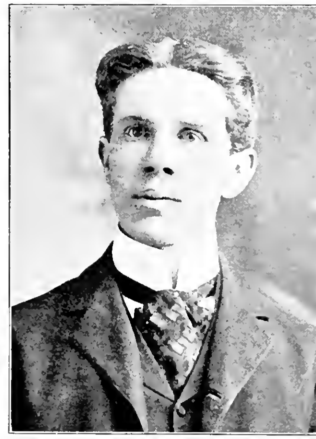
MR. I. H. BRECK, Electrician.

street, about 100 yards from the City Hall. It is in sight of both railway stations, and near the city wharves. The street cars pass directly in front of the hotel.

Electrical time detectors manufactured by the Cleveland, Ohio, Electrical Co., are used at the Cotton Mill, Anglin's Wood Yard, Locomotive Works, Kingston Foundry and by the Montreal Transportation Company.

There are three well equipped telegraph offices in Kingston. Mr. Wm. Bamfield is general manager of the North American Telegraph Co.'s branch, Mr. R. J. Wilson conducts the C. P. R. Telegraph Co.'s local office, and Mr. James Kearns has control of the G. N. W. Telegraph Co.'s city business. All three offices are on Clarence street.

Several of the illustrations shown were obtained through the courtesy of Mr. Breck. In addition to his



MR. R. BOYD, Electrician.

electrical knowledge, he is an excellent amateur photographer.

## PROGRAMME.

**WEDNESDAY, AUGUST 29th.**—Meeting of Executive Committee at Hotel Frontenac, 9 a.m. sharp. Opening of Convention at the Hall (City Hall Chambers or Hotel) 10 a.m. Order of business: (1) Welcome by Mayor of Kingston; (2) President's Annual Address; (3) Reading of Minutes of last Meeting; (4) Report of Secretary-Treasurer; (5) Reports of Standing Committees; (6) Appointment of Nominating Committee; (7) Reading and Discussion of Papers; (8) General Business. (To be continued into the Afternoon Session which will begin at 2.15 p.m.)

**THURSDAY, AUGUST 30th**—10 a. m.—Consideration of President's Address and Reports of Secretary-Treasurer and Standing Committees; Election of Standing Committees; Reading and Discussion of Papers; General Business. (To be continued into Afternoon Session—2.15 p.m.)

**FRIDAY, AUGUST 31st.**—10 a. m.—Selection of Place of Next Meeting and Approximate Date; Election of Officers and Executive Committee; General Business.

### SOCIAL FEATURES.

**WEDNESDAY, AUGUST 29th.**—7.30 p. m.—Complimentary search-light excursion among the Thousand Islands, tendered by the Mayor and citizens of Kingston.

**THURSDAY, AUGUST 30th.**—9.30 p. m.—Annual Banquet at Hotel Frontenac.

**FRIDAY, AUGUST 31st.**—Excursions will be arranged for the afternoon, and at 8 p.m. a grand spectacular band concert by the famous 14th Regimental Band, introducing an electrical musical fantasy of the Battle of Paardeberg, with electrical effects and fireworks.

### LIST AND ORDER OF PAPERS.

1. "Use of Dynamo and Storage Battery in Telegraph Offices."
   Mr. W. J. Camp, C.P.R. Telegraph Co., Montreal.
2. "Utilizing the Available Central Station Capacity."
   Prof. R.B. Owens, McGill University, Montreal.
3. "Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps."
   Mr. F. H. Leonard, jr., Montreal.
4. "Conditions Affecting the Wave Form of Alternators."
   Prof. L.A. Herdt, McGill University, Montreal.
5. "Rotary Converters."
   Mr. A. Gordon Grier and Mr. J.C. Hyde, Montreal.
6. "Railway Subject, Giving Several Curves Showing up the Average Power During a Day, and Maximum and Minimum Requirements for Power Called For on the Quebec System."
   Mr. Blair, Quebec Railway & Lighting Co., Quebec.

In order to give closer attention to their Canadian business, The Edwin C. Lewis Company, electrical contractors, of Boston, have established an office in the Temple Building, Montreal, which will be under the management of Mr. Philip Lahee, who has been associated with them for the past ten years.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

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The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**


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Vice-President, P. R. COLPITT, City Electrician, - - "
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## ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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**How to Become an Electrician.** THE eagerness of young men to enter the electrical business shows no signs of abatement. The superintendent of one of the Canadian electrical manufacturing companies states that he receives on an average twenty applications per week from youths wishing to enter the factory as apprentices. These applications come from all parts of the country. Many of the applicants have a very indefinite idea of the work which they will be called on to perform. They seem to think that an electrical manufactory is a place where a large amount of experimental work is done. On entering, they find that most of the work is purely mechanical and by no means clean; that the experiments and tests which are made from time to time are for the first few years beyond their comprehension; that they are confined for many hours each day within doors, and are required to give close application to whatever work may be given them to perform. All this is contrary to their preconceived notions, and as a consequence many abandon the business and turn their attention to something else. In the opinion of the above-mentioned superintendent, the best preliminary training for the young man who wishes to work his way up in the electrical business is two or three years' experience in a machine shop.

**Canadian Electrical Association.** THE Executive Committee, at a meeting held a fortnight ago, decided to accept the cordial invitation extended by the city council and electrical companies of Kingston to hold the annual convention this year in the Limestone City. This decision meets with the approval of the members and friends of the Association in Ottawa, which was to have been the place of meeting. It is felt that, owing to the disorganized condition of affairs in that city at present, due to the recent disastrous fire, the convention could not conveniently be held there this year. As will be observed by the illustrations and descriptions appearing in this number, Kingston is an interesting city. Situated in close proximity to the Thousand Islands, a locality famous the world over for its natural beauties as well as the beautiful and unique character of the summer residences erected upon the islands, the surroundings as well as the city itself will repay a visit. Kingston's location, midway between Montreal and Toronto, and conveniently reached by rail or water from all points of the compass, adds to its suitability as the place of meeting, and should assist to ensure a large attendance.

The programme prepared for this convention is one of the most interesting and instructive that has ever been placed before the members. It is printed in detail in another column. The papers cover a wide range of subjects relating to various departments of electrical work. The standing of the authors is a guarantee that the matter of these papers will be interesting and instructive. This being the case, the discussions should be full and profitable. A new feature will be introduced this year by providing, without charge, by courtesy of the city authorities and the Kingston Light, Heat and Power Co., space, current and labor to manufacturers who may wish to install exhibits of electrical appliances. A cordial invitation is given to manufacturers and dealers in electrical supplies to avail themselves of this offer. The Kingston Street Railway Co. has offered to carry free, all persons wearing the Association badge and

to supply extra cars for special trips. The city council have appropriated the sum of $200 for the entertainment of the visitors, and have appointed a committee to assist in making the necessary local arrangements. The city council chamber has been placed at the disposal of the Association for the convention, and space in the City Hall for exhibits. An afternoon and evening trip among the Thousand Islands will form a delightful feature of the programme of entertainment.

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A large turnout of the members of the Association is looked for at this convention. A cordial invitation is also extended to persons connected with any branch of the electrical industry to become members and take part in the approaching convention. During the last two years the Association has done valuable service in protecting the interests of electric lighting companies. Such of these companies as are not already represented on the membership of the Association should now make make connection with it, give it the benefit of their support and ideas and assist to place it in a position to exercise still greater influence in behalf of electrical interests.

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**The Operation of Synchronous Motors.** A superficial comparison between the action of the synchronous and of the direct current motor with which we are all so familiar generally leads to the view that they are direct opposites. In the effects produced in actual operation in many respects they are, but in the principles involved when allowances are made for the different actions of direct and alternating currents, the results attained are seen to be such as might have been expected. The practical operation of the direct current motor shows that it possesses high starting torque' that it may be run at any desired speed, and that its current consumption varies with its power output. On the other hand, the synchronous motor develops small starting torque, it runs at an absolutely unvarying speed, which is fixed by the generator from which it is driven, and can exert but little turning effect except at that fixed speed, and its output in power is frequently not commensurate with the current input. For these reasons, where variable speed with a large torque is required, the direct current motor is the most suitable, while if it be desired to have an absolutely uniform speed, the synchronous motor holds the field. These differences in action are due primarily to the pulsating character of the current supplied to the synchronous motor as distinguished from the pulseless direct current operating the direct current motor. The results are that while in the direct current motor there are two E.M.Fs., the impressed and counter E.M.F., in the other there are three, the impressed, counter and reactance E.M.Fs. In the first case the impressed and counter E.M.Fs. act in opposite directions; in the second they may or may not be directly opposite. A rise of voltage in the first case means increased speed, in the second no increase of speed, but an increase of wattless current.

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Probably the most instructive method of comparing the actions of the two motors is to consider the action of two engine driven direct current dynamos feeding into the same set of bus bars, and two alternators under similar conditions. If in either case the driving belt be thrown off one machine, it becomes a motor driven from the other. In the case of the direct current machine the speed drops somewhat until the counter E.M.F. is so reduced that enough current enters the motor to allow it to overcome its own friction, and if a load be placed upon it a further decrease of speed follows. In the case of the alternating dynamo, its speed being fixed as rigidly as if it were geared directly to the other alternator which is supplying current to the bus bars, in order that enough current may flow to operate it as a motor it drops back in phase behind the impressed E.M.F., but not enough to throw it out of synchronism, and as the load increases so does the angle of lag between the E.M.Fs. In case the load became excessive, say three or four hundred per cent. of full load, the motor would lose synchronism and immediately come to rest just as it would were it gear driven and the teeth of the gears stripped off. Considered in this way, the direct current motor adjusts its input to the load to be carried by change of speed, while the synchronous motor automatically adjusts the angles at which its three E.M.F. act so as to allow combined pressures to force enough current in phase with the active pressure to operate the load. In fact, the synchronous motor is in every respect an alternating dynamo and uses the same station equipment with the addition of some starting apparatus and a larger exciter. In operation some means of starting is employed, either a resistance or impedence to keep down the rush of current as in the direct current motor starter, or by using a compensator which is a transformer with a variable ratio of primary to secondary E.M.Fs., enabling the motor to start on a low voltage, which is then gradually increased up to the running pressure. The above apparatus is used where the motor is not required to start under full torque, but still to be self starting. By these means a starting torque of about 25% of full may be obtained with not much more than full load in amperes. Where the motor has not enough torque to start from rest without assistance, a starting motor or a friction clutch, or both, are used, the main motor is driven to synchronism, and when in phase opposition to the supply current it is thrown in as a motor.

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In operation a few points may be noted as being peculiar to the synchronous machine. The speed is independent of the voltage applied, but the torque varies as the square of the voltage, so that the pressure of supply should be kept up at least to the rated volts of the motor, and preferably higher. Under proper conditions the motor may operate at five hundred per cent. over its rating before breaking out and coming to a stand still. Where the motor is self starting it should be noted that when starting the fields are subjected to the inductive action of the current flowing in the armature and become practically the high voltage side of a transformer, and while, of course, the field circuit is not closed under the condition of self starting, and no current can flow in them, the high voltage introduced by induction places a great stress on the insulation of the coils to ground. To obviate the danger of puncturing, the fields are generally arranged to be cut in several places by a switch which is opened when starting. Probably a better method is to use few turns on the field with a low voltage exciter giving large currents; this method of avoiding the trouble depending, of course

upon the fact that the voltage induced in the field coils is proportionate to the number of turns in the coils.

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One of the most valuable properties of the synchronous motor is its ability to overcome the lagging currents on the lines of long transmissions, which is accomplished by raising or lowering the excitation. The reasons for this ability to operate in this manner will be seen when it is remembered that the impressed E.M.F. is dependent upon the generator, the counter E.M.F. upon the excitation of the motor, and the reactance E.M.F. upon the load. The first being thus fixed and the latter usually out of the control of the motor operator, leaves the counter E.M.F. available for regulating the lines. As this counter E.M.F. depends, just as in a dynamo, upon the speed and the excitation, and as the first in the case of the synchronous motor is fixed, a variation in the exciting current might be expected to produce various results depending upon that excitation, and this is found to be the case. If the exciting current be varied while the motor is running under steady load, it will be found that at one point the input of current to the motor terminals is a minimum, and that as the excitation is either raised or lowered within limits, the current required to operate the motor is increased.

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As the heating of the motor is dependent upon the current taken, independent of whether this is useful or wattless, that point of excitation is usually selected which gives the lowest current reading of motor input. In some cases, however, where it is advisable to overcome the inductive drop in long lines, the excitation may be increased so that the counter E.M.F. becomes greater than the impressed, when the motor acts as a condenser, and gives leading currents to the lines. Where a load of induction motors at the end of a long line gives a large inductive drop owing to the wattless currents flowing, a large synchronous motor over excited will be found to help out the transmission by supplying leading current to counteract the wattless, but it must not be forgotten that as the capacity of the synchronous motor is limited by the currents, whether active or wattless, which flow in its windings, it cannot be called upon for help to the others if it be already loaded to its capacity by its own load. Fortunately for the type, when the excitation is set at any load so that the motor will operate with a power factor of one, or in other words consume the least current for that particular load, any change of load will not be found to affect the required excitation quality. In other words, the excitation once set will be suitable, generally speaking, for any load within the capacity of a good type of motor.

## NEW DESIGN FOR A COMPOUND DUPLEX PRESSURE PUMP.

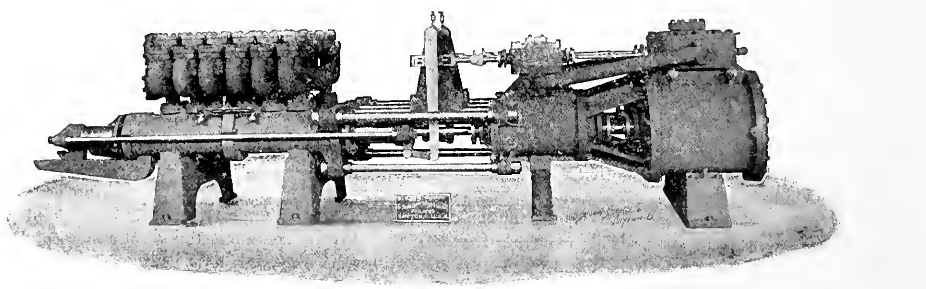
The illustration given herewith is for a compound duplex pressure pump to develop a maximum pressure of 700 lbs. per sq. in.

The liquid end is of the end packed trombone style, the cylinders being made of special metal. Mounted thereupon are separate chambers for the location of the valves; chambers are also constructed of special metal and designed with a view of facilitating quick access for the inspection of the valves.

The valves are of the hydraulic pattern, made of steel and guided from below. An extension piece is provided for supporting the water plunger, and an approved adjustment device provided therefor.

The water end is mounted on heavy supporting columns. An engine of the transposed cylinder type is furnished, giving free access to all steam pistons without dismantling the pump.

The outside valve adjustment is a feature of this design. Further particulars regarding this style of pump can be obtained from the manufacturers, The Stilwell-Bierce & Smith-Vaile Co., 278 Lehman street, Dayton, Ohio, U. S. A.



Smith-Vaile Compound Duplex Pressure Pump.

## ANNUAL REPORT OF ROYAL ELECTRIC COMPANY.

The seventeenth annual meeting of the Royal Electric Company was held in Montreal on July 17th, at which the chief business was the reception of the annual report. The report in part stated:

The gross amount to credit of revenue accounts for the year aggregated $1,519,911.76; the gross amount to debit of revenue accounts for the year aggregated $921,980.27; leaving a balance of $597,931.49; from this is to be deducted: Interest and fixed charges to the sum of $41,239.06; leaving a net profit for the year of $556,692.43. Of this net profit the sum of $300,000 has been realized out of the investment in the Chambly Manufacturing Co.

Out of the above earnings there have been declared four quarterly dividends of two per cent. each, to the total amount of $157,026.14, leaving the sum of $399,666.29.

During the year expenditures have been made for additions to the plant of the company, as follows: To the factory and its equipment, $37,458.51; to the lighting stations, lines and installations and general construction, $135,106.34; making a total of $172,564.85.

The total net increase added to and connected with the alternating current system during the year was the equivalent of 14,460 incandescent lamps of 16 candle power each, and 2,176 horse power capacity in motors. The volume of business in the city, as well as many orders for electrical machinery and apparatus manufactured by the company, has been very satisfactory and gratifying.

The directors have made arrangements with the Chambly Manufacturing Company, which, subject to your approval, will enable your company to contain and control the whole of the power produced by that company on the Richelieu river, and to dispose of the stock and bonds which it now owns in that company upon advantageous terms; the whole in lieu of the contract now existing.

The agreement with the Chambly Manufacturing Company regarding the purchase of power was ratified. The terms of this agreement extend over a period of fifty years, and at the end of that time the whole reverts to the Chambly Manufacturing Company. The Royal Electric Company is to pay fifteen dollars per horse power for the first 15,350 horse power, and for all in excess of that amount at the rate of ten dollars per horse power.

The following were elected directors of the company for the coming year: Rodolphe Forget, J. A. L. Strathy, J. R. Meeker, H. B. Rainville, George Caverhill, James Wilson, F. C. Henshaw. At a subsequent meeting of the board, Mr. Forget was appointed president, and Mr. James Wilson vice-president.

In answer to a question, Mr. Browne stated that about 12 per cent. of the power will be lost in transmission from Chambly. The Chambly company reserve the right, if the Royal Electric do not exert themselves to obtain customers, to canvass themselves; but not to sell at a lower price.

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**If not already a member of the Canadian Electrical Association, you are invited to join the organization and participate in the approaching convention at Kingston, which will afford opportunity to make new acquaintances, renew old ones, and store up a stock of valuable information and enjoyment.**

PROF. L. A. HERDT, MONTREAL.

MR. W. J. CAMP, MONTREAL.

MR. F. H. LEONARD, JR., MONTREAL.

PROF. R. B. OWENS, MONTREAL.

MR. A. G. GRIER, MONTREAL.

AUTHORS OF PAPERS, CANADIAN ELECTRICAL ASSOCIATION CONVENTION, KINGSTON, 1900.

## PLYMOUTH CORPORATION ELECTRIC WORKS.

By Burcham Harding.

The ceremony of opening the Plymouth Corporation Electric Works at Prince Rock, and the inauguration of electric tramways, took place September 22nd last. Plymouth was the first town in England to be incorporated by Act of Parliament, and was equally the first city to design an electrical plant combining both lighting and power. The business of the corporation has had so rapid a growth that within six months of commencing operation a contract has been placed which will double the supply of current.

The power plant is built on corporation land at Prince Rock, on the Cattewater, the estuary of the river Plym. Three Lancashire boilers, rated at 350 horse-power each, furnish steam; they are operated at a pressure of 130 pounds, but are constructed for a working pressure of 160 pounds to obviate reducing the working pressure as the boilers become old. Welsh coal is delivered by steamer to the wharf alongside the power house, and a branch of the London and South Western Railway runs in front of the works, which are thus supplied with ample accommodation both by land and water. Mechanical cokeing stokers are fitted to each boiler, and a complete system of coal handling arrangements conveys the supply of fuel mechanically from the coal stores to the furnaces. An electric motor operates the mechanical stokers. An economizer of 256 tubes has been erected beside the boilers. A cast iron tank holding 28,000 gallons, upon the roof of the coal store, is fed by a three inch pipe from the town mains, the supply of water being paid for at 2d. (four cents) per thousand gallons. Alongside the power house there will shortly be constructed a refuse destructor for the town garbage. The electricity committee of the Corporation will pay the works committee, who are responsible for the destructor, at the rate of one farthing (one-half cent) per k.w. hour of electric energy produced. This arrangement will make a considerable saving in the cost of fuel for the electricity works, and will give over $7,500 a year to the credit of the destructor.

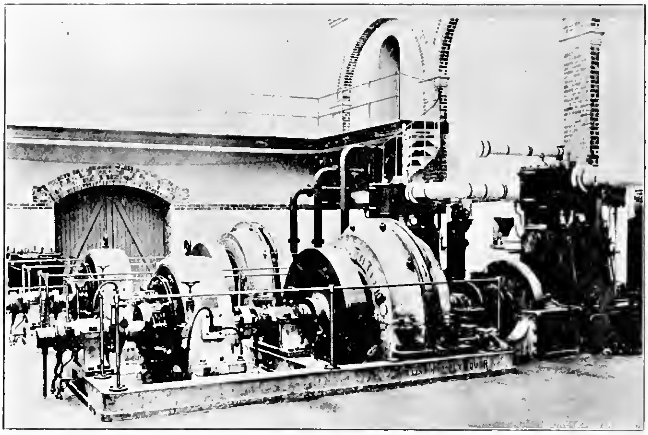

Fig. 1.—100 K. W. Westinghouse Direct Current Generators and Alternator.

The generating machinery is contained in a building constructed principally of limestone. The spacious and lofty machinery room is designed to accommodate further units than are at present erected. The lighting and power plant are coupled together in a somewhat ingenious manner. The electrical equipment of the tramways was carried out by the Westinghouse Electric Company, Limited. Illustration No. 1 shows two sets of generators, each unit consisting of a high speed compound engine of 150 h. p. and 275 r. p. m., direct coupled by means of a friction clutch to an alternator of 100 k. w., and also to a Westinghouse direct current generator of 100 k. w., both being on the same side of the steam engine. The engine is capable of driving either the alternator or the generator at full load, or both at half load, or each one in such proportion as the calls for alternating or direct current may require.

A storage battery of 260 Tudor cells is in parallel with the generator. During the day the engine can be run at full load, the alternator supplying whatever small amount of current is required for lighting, and the generator supplying direct current for the tramways. The storage battery, in parallel with the generator, provides for any heavy demand for the tramway service, any current beyond the needs of the tramway line being stored by the battery. By this means a practically constant load is kept upon the engines, and the cells of the battery are continually being charged or are discharging, according to the demand of the circuit.

During the evening the demand for current for lighting purposes increases, and the supply of current for the tramway line is gradually taken off the generator and supplied by the battery, leaving the engine free to drive the alternator at full load for lighting. After midnight, when the lighting circuits are virtually closed and the cars have ceased running, the generator is driven at full load for charging the battery, until six o'clock in the morning, when the cars again commence to run.

The power house also contains two 200 k. w. alternators, supplying current for lighting, driven at 250 r. p. m., and a 20 k. w. booster, motor driven, used in series with the D. C. generator so that the bus-bar pressure need not be raised. The booster generator is so arranged that when the demand for current is equal to the output of the generator, the battery will neither charge nor discharge. When the line current is less than the output, the booster will aid in the charging of the cells. When the line current is greater than the output, the booster will add a pressure to the battery circuit and thus help it to discharge.

Between each of the engines and the alternators and Westinghouse generators shown in the illustration, is a special shaft coupling, so that the engine can be disengaged when desired. The use of the clutch enables the generator and alternator to be used independently of the engine. On Sundays when no cars run, the generator is operated as a motor from the storage battery, driving the alternator for whatever light load there may be. Similarly, the alternator can be run as a synchronous motor from either of the other alternators in the station, and the D. C. generator used either for charging the battery or for tramway work with the battery in parallel. This plant was designed some two years ago, but if it were designed to-day, according to the latest Westinghouse practice in the United States, instead of separate alternators and generators, a combination A.C.-D.C. generator would be employed.

The storage battery consists of 260 Tudor cells, of 600 ampere hours capacity, the maximum discharge rate being 200 amperes. The Tudor Company maintain the battery under guarantee for ten years at a rate of five per cent. on the original cost. The contract stipulates that at any time within twelve hours of being fully charged, the battery must give its full specified capacity of 600 ampere hours without the voltage per cell falling below 1.85 volts.

The power house is equipped with three switchboards for the lighting and power circuits, which are erected on a gallery upon two sides of the machinery room. The alternating current switchboards is of the ordinary pattern, arranged on the single pole principle. The direct current tramway switchboard is of the usual Westinghouse design, being shown in Fig. 2, and is fitted with instruments for controlling and regulating the current. The regulating resistances are fixed in a room immediately under the swithboard recess.

The length of the tramway lines already opened is 3 1/10 miles, running from the Theatre Royal to Prince Rock, but this is only a part of the projected line. Extensions are being made to Hyde Park, at Mutley, and from the Market Place to Compton, passing through the residential district of Mannamead, and later on will be further extended to Pounds and Lipson. Now that these additional lines are approaching completion, the present type of combination generators will not be continued, but there will be installed a steam driven direct current Westinghouse generator of 500 k. w., a battery for 1700 ampere hours at Compton, a 36 k. w. booster, and a 200 k. w. motor alternator.

Five direct methods of carrying the overhead wires have been employed to suit the character of the road. Owing to the great number of telegraph and telephone wires, guard wires have been used for more than half the route, which rather distracts from the

exceptional artistic appearance of the overhead construction. The poles are three sectional, with S. S. S. joints, of 7 inches, 6 inches and 5 inches outside diameter, with heavier poles of 8 inches, 7 inches and 6 inches diameter at curves. There are a few single tube poles, 8 inches in diameter for half way and then tapering to 6 inches at the top. Arc lamps are fixed on the top

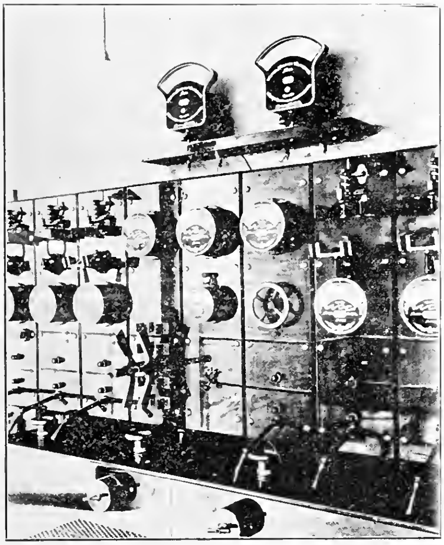

FIG. 2.—WESTINGHOUSE SWITCHBOARD.

of alternate poles in a number of the streets, and where possible on alternate sides of the street, a fiddle bow suspension, between the ears, holding the wires, has been fitted to avoid oscillation of the lamps. The line is divided into ½ mile sections, according to the English Board of Trade requirements, and insulated in the usual manner. Of the section boxes, two have been very neatly built into the walls of the Corporation building. They contain four switch fuses, lightning arrester, telephone and wire terminals.

The motor cars have a seating capacity for twenty inside and twenty-two outside. Each car is fitted with two Westinghouse No. 46 motors, giving 1,000 pounds tractive effort, at eight miles an hour. The controllers are of the Westinghouse series parallel type, with graded brake. Perfect control is kept over the car by putting the two motors in parallel, and by connecting them by a variable resistance, if necessary to the extent of short circuiting the motors. This brake has been working very satisfactorily. The tracks are double nearly all the way. The rails are grooved girder section, 92 pounds, 30 feet in length. The extensions are laid with sixty foot rails. Each joint is bonded with three No. 000 Chicago bonds, 30 inches long. The tests of the conductivity have given most satisfactory results. Probably no more difficult piece of tramway equipment has yet been completed in England, since the three miles already laid is through tortuous and narrow streets with extremely sharp curves.

The combination of supplying both light and power from the same units enables the Corporation to fix a low price for tractive purposes and for lighting circuits. In fact, Mr. Rider, the electrical engineer of the Plymouth Corporation, in a speech made at the opening ceremony, stated that the prices charged were the lowest that had ever been offered at the opening of any electricity works. The tramway is charged 3½ pence (seven cents) per unit up to 150,000 units per annum; beyond this figure there will be a reduction in price. The contemplated extensions to tramway lines will necessitate some 600,000 units, the price for which, it is estimated, will be reduced to 2.3 pence (under five cents) per unit. The price for lighting for private customers is 4½ pence (nine cents) per unit, and the same rate has been made for public lighting. The charge for an arc lamp, including cost of cleaning and maintenance, for one year is £16 ($77.00). According to Mr. Rider, the cost of electric lighting in Plymouth is about double that of gas, but the former gives about twenty times as much illumination as the latter, so that in effect the public by using electricity obtain ten times as much value for their money. Twenty-one miles of mains have been laid on the three wire system of distribution, and a large number of houses and stores are being connected up. At the date when the plant was started, connections had been made for 5,000 lamps, and applications in hand showed that this number would be increased to 8,000 before the end of the winter.

The expectations of the resident engineer appear to have been more than realized, since the demand for current has already outrun the station capacity, and a contract has been placed with the British Westinghouse Electric & Manufacturing Company for a 500 k. w. direct current 550 volt engine type generator, to be direct connected to a steam engine running at 330 r. p. m. Two boilers of 350 h. p. each will be added to the present equipment.

For the summer railway traffic fourteen new cars are being built, to be equipped with Westinghouse No. 46 railway motors.

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The telephone exchange at St John, N.B., is to be thoroughly modernized, at a cost of upwards of $100,000.

The Vernon, Nelson and Kootenay Telephone Company are extending a line from Kootenay to the B. C. Mines.

The electric railway from Quebec city to Ste. Anne de Beaupre, built by the Quebec Railway & Lighting Company, is about to be opened.

The Bell Telephone Company have just put down an underground cable on Portage avenue, Winnipeg, said to be the largest yet used in Canada.

The Bell Telephone Company have recently completed a copper metallic line from Three Rivers to Shawinigan Falls and Grand Mere, Que., thus connecting those places with Montreal, Toronto and other large cities.

The T. Eaton Company, Toronto, have placed an order with the Canadian General Electric Company for two 225 kilowatt, 125 volt direct current generators. These will be direct driven by Robb engines. The installation when completed will, with one exception, be the largest isolated plant in the Dominion, the other being that of the Montreal Cotton Company at Valleyfield, Que.

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**It is expected that there will be a number of interesting exhibits of electrical and kindred appliances in connection with the annual convention of the Canadian Electrical Association to be held at Kingston on the 29th, 30th and 31st inst. Space, current and labor for this purpose are supplied free of charge to manufacturers and dealers.**

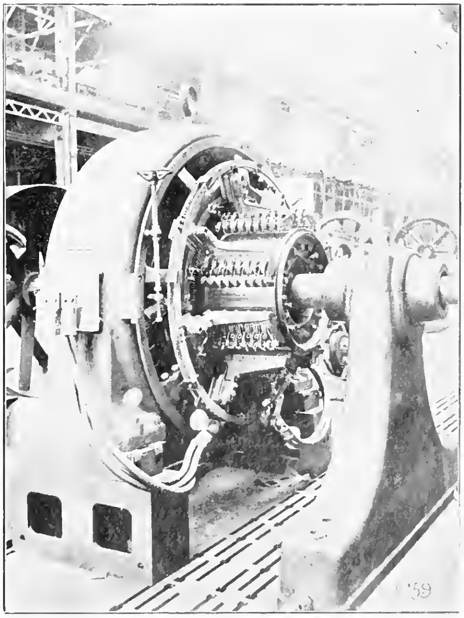


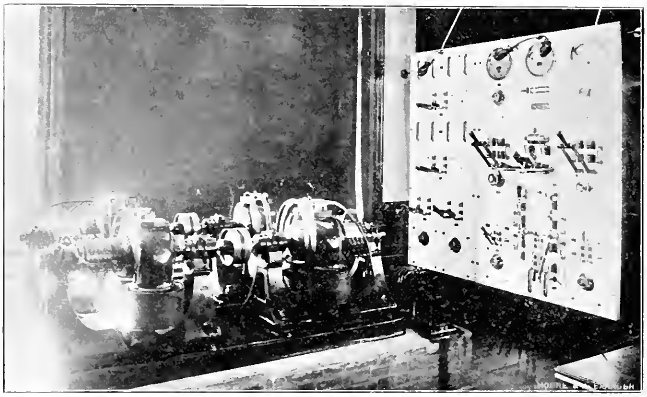
FIG. 3.—WESTINGHOUSE 500 K. W. DIRECT CURRENT GENERATOR—500 VOLTS.

# TELEGRAPH and TELEPHONE

## OTTAWA EXCHANGE OF THE BELL TELEPHONE COMPANY.

On April 12th, 1900, the lines of the Bell Telephone Company's subscribers in Ottawa were transferred from the old switchboard to a new one of the most recent type. The work necessitated by this transfer had been going on for over twelve months, during which time every line in the exchange system had been entirely rebuilt, giving all subscribers metallic circuits of copper and phosphor-bronze wire.

All lines entering the company's building on Queen street come in in cables through the basement from the street underground system. These cables vary in size from those containing 50 pair of wires to large ones of 200 pair capacity. The underground system has been greatly extended during the past year, until at present there are about 3,000 miles of telephone wires underground in the city of Ottawa. From the basement the cables are carried up a chute to an iron distributing frame in which changes of the location of the terminals of the lines are made and from which all testing is done. Here the cables are terminated in rubber-covered wire ends, which are attached to the protecting arrestors put into the line circuit, to prevent injury to the apparatus should an abnormal current of sufficient strength to do harm be conducted on to the line wires. From the main distributing frame the lines are carried in small 20 pair flexible cables to the intermediate distributing frrme, a structure similar in construction to the main distributing frame and from which cables are led direct to the switchboard. Connected to the intermediate frame is a relay rack on which are mounted the relays which control the various lamp signals on the switchboard.



Bell Telehhone Exchange, Ottawa—Machines and Power Switchboard.

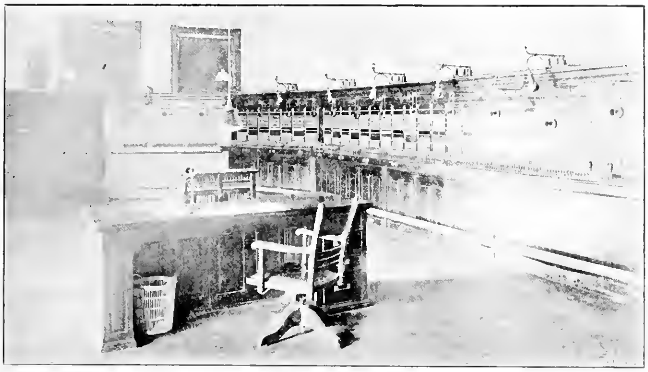
The necessary current for the operation of the switchboard and for the subscribers' transmitters (this being a common battery or central energy system in which local batteries at subscribers' stations are done away with, and all instruments are operated by one large battery at the central office) is furnished by a battery of eleven type "G 15" chloride storage cells having a capacity of about 1,200 ampere hours. For charging this battery two Western Electric dynamos, direct coupled to motors of the same make, are provided; one motor being run from a 500 volt circuit and the other a 250 volt circuit, thus giving an alternate charging machine in case of a break-down, either of the motor-generators, or of either of the outside power circuits.

Two dynamotors to furnish current for ringing the subscribers' bells are provided and arranged to be run from the storage battery. The switches, protectors, measuring instruments, etc., used in connection with the power plant are mounted on a marble switcboard in a convenient location near the machine, and large mains carry the current from this switch to bus-bars, which are mounted on a marble panel in the operating room, and from which panel leads are carried to the various sections of the switchboard. Protecting fuses are also mounted on this panel.

The last, but by no means the least important piece of apparatus in the exchange, is the switchboard itself. This is radically different in its mode of operation, though not in its appearance, from any other of the older types of switches. Formerly it was necessary, when a subscriber wished to call the central office, for him to ring the bell on his instrument, thus operating an annunciator in the central office; he then removed his telephone from the hook and waited for the operator to answer; it was necessary for the operator to restore this annunciator by hand. When the conversation was completed, the subscriber rang off (perhaps), displaying another signal similar to the annunciator, upon which the operator listened in on the line to see if the conversation was finished or if another connection was wanted. On account of a great many subscribers not ringing properly, it was necessary, in order to give good service, for the operator to come in on the line occasionally to see if the subscriber called for had answered, or ascertain if the conversation was compieted, without a disconnect signal being sent in. This gave rise to the more or less annoying questions to the operator, "Have they answered?", "Are you finished?" etc.

The present system is designed to obviate all this. A subscriber signals the central office by removing his telephone from the hook, which act lights a small incandescent lamp in front of the operator at the central office. Before her are a number of pairs of cords and keys similar to the usual operator's equipment, but with the addition of a small incandescent lamp connected in the circuit of each cord of the different pairs. The operator answers the subscriber by inserting a plug into a jack, or connecting point, immediately above the signal lamp; by so doing the line lamp is extinguished. The other cord of the circuit is then inserted into the connecting jack of the line called for and the subscriber is rung up in the usual way. Until he answers by removing his telephone from the hook the lamp connected with the cord circuit remains lit, being a signal to the operator that the subscriber has not answered and that she is to continue ringing until he does so. When both lamps in the cord circuit are out, it signifies to the operator that the conversation is in progress.

When both lamps light, it is a positive signal to the operator that both subscribers' telephones are on the hook and that the conversation is completed. When one or both lamps flash intermittently, it shows that one or both the subscribers are moving the switch hooks of their telephones for the purpose of attracting her attention. When a conversation is started, it is unnecessary for an operator to cut in on the line for any purpose, unless she sees this intermittent flashing of the lamp; in this way, interruptions to the subscribers' conversations are reduced to a minimum and the greater part of an operator's work is done by the eye, rather than the ear, making her work simpler and less arduous. The general result is a more satisfactory service all round.

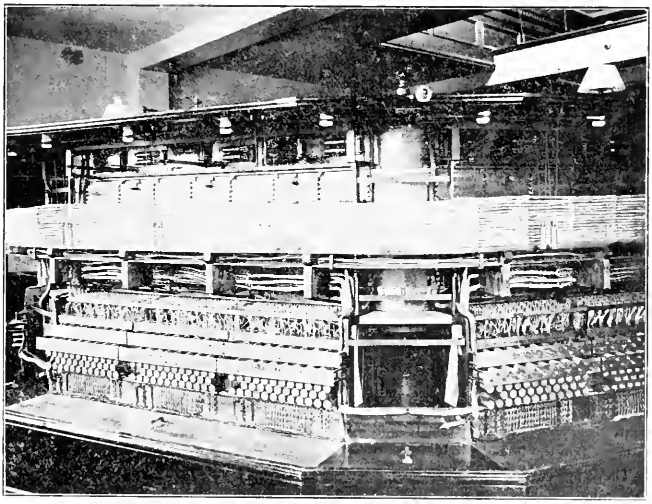


Bell Telephone Exchange, Ottawa—Portion of Main Switchboard.

The long distance calls are handled at special sections of the switchboard in a manner very similar to the method described above; all calls being timed by a special recording machine, called a calculagraph, which reduces errors in time record to a minimum. New sets are now being installed in all subscribers' stations, and by the time this work is completed, the city of Ottawa will have a telephone equipment and service not surpassed by any city in America.

With the exception of the storage cells, charging and ringing machines, lamps, and cable, all apparatus used in the exchange and subscribers' stations was manufactured by the Northern Electric & Manufacturing Co., Montreal.

The plant was installed under the direction of the electrical engineering department of the Bell Telephone Co.



Bell Telephone Exchange, Ottawa—Rear View of Switchboard.

The Bell Telephone Company have just installed in the Goldie & McCulloch works, at Galt, Ont., a private telephone exchange, including five desk telephones and seven regular wall instruments. The Goldie & McCulloch Company also have a long distance equipment, and possess one of the most complete telephone systems in Canada. The Bell Telephone Company have also installed a ten set warehouse system for MacGregor, Gourlay & Co., and a seven set system for the C. Turnbull Company, all of Galt.

## TELEGRAPHY IN THE ATLANTIC.

Mr. F. A. Hamilton, E.E., of Halifax, N. S., has recently completed his commission by the Commercial Cable Company in connection with the laying of a cable from Canso, N. S., to New York. In an interesting communication to the Electrical News, Mr. Hamilton says:—

"I am now testing the new Canso-New York cable during the gaurantee period, likewise the Canso-Azores cable recently laid by the "Faraday." This is an eventful year in respect to Atlantic telegraphy. Besides the last mentioned cable laid by the Sienems Bros., Ltd., from their ship the "Faraday," the India Rubber & Gutta Percha Company, with the "Silvertown," have laid the section which I am now testing. This cable is 895 nautical miles in length, and was paid out between July 10th and July 21st. Then there is the German cable now about to be laid by the S. S. "Anglia," belonging to the Telegraph Construction and Maintenance Co. All these companies' works are, as you know, on the Thames. The "Silvertown" is the oldest ship of the three. She was built by Mitchell & Co., of Newcastle, one year before the "Faraday," and is the larger vessel of the two. The latter vessel was built in the same stocks. The "Anglia" is the latest addition to the great telegraph fleet of the world. She is expected to arrive in New York on the ninth of August."

Mr. Hamilton has recently been appointed by the U. S. A. Signal Corps to accompany an expedition to the Phillipines, and expects to leave for New York immediately on the completion of his present contract. He will probably be absent about two months.

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The Manhattan General Construction Co., of Newark, N. J., advise us that although midsummer is usually a dull season for arc lamp business, their orders for July, 1900, exceeded those for any one month in their experience, extending over the past seven years. The Manhattan Series A. C. System is being adopted very rapidly, a few of the orders closed recently being: Evanston Electric Ill'g Co., Evanston, Ill., 211 lamps; Fairport Electric Co., Fairport, N. Y., 60 lamps; W. M. Sheehan & Co., Wappinger Falls, N. Y., 52 lamps; Hagerstown Municipal Plant, Hagerstown, Md., 117 lamps; Town of Phillipi, W. Va., 20 lamps; Urbana Lt., Ht. & Pr. Co., Urbana, Ill., 78 lamps; N. Y., N. H. & H. R. R., Hartford, Conn., 50 lamps; Hamilton Electric Lt. & Pr. Co., Hamilton, Ont., 200 lamps. In addition to shipping 350 series A. C. lamps to the Northern Ohio Traction Co., of Akron, O., the Manhattan Company have received their order for 350 multiple A. C. enclosed arc lamps.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building.

MONTREAL, Aug. 6, 1900.

The Lachine Rapids Hydraulic and Land Company are to be congratulated on the manner in which they managed to keep their service going after their late fire at the McCord street distributing station, the delay being trifling. In fact, when one looks at such fires as occurred, for instance, in Toronto, and more recently Ottawa, where do we find any industry that works so unflaggingly to repair fire damage? In giving evidence regarding the fire, Alfred C. Reid testified that when the fire started he was in the switchboard room with Messrs. Dorais and Roberts. The switchboard was in the part facing on Seminary street. He was looking towards the switchboard, suddenly heard a roaring noise and saw issuing from the switchboard a large peculiar flame. The flame was about six feet from witness, who called to the men to get some sand to throw on the flames, for they could not use water. The switchboard was of maple and birch. On the back there was asbestos, and the switchblocks were on slate, and everything arranged so as to make the place as safe as possible. The sand put out some of the fire, but the flame was so hot that they could not get nearer than ten feet, and the flames presently extended to the other insulators. The heat melted the insulating covers and the flames extended in all directions. There are nine main wires coming to the switchboard from the transformers. The board in which the fire caught held only wires of 2,000 volts.

Quite a number of gasoline launches are now in vogue amongst our suburbanites, at Lachine, on Lake St. Louis, and elsewhere. Referring to those which utilize the gas and "fire" it with the electric spark every revolution or second revolution: How many owners have become disgusted, and probably blamed a good engine and boat simply through using improper batteries? Quite a number have sal-ammonic cells, and some even dry cells, although it is distinctly marked on them for "open circuit work." Now, such work can hardly be called "open circuit," and if some of the disgruntled ones will try one or other of the numerous makes using elements of copper oxide and zinc in a solution of caustic potash, they may find a change for the better. Such cells will run on "closer circuit" work, and this is pretty much what the service required is. It is necessary to have a cell or two more of these than of the sal-ammoniac or dry varieties, owing to their lesser voltage. A reserve set of dry cells, to carry you in should others fail, is not a bad precaution. Some iron contact pins are also in vogue; such should certainly be tipped with platinum, or preferably "platino-iridium," which, although more expensive, are harder and wear longer. Another point—do not connect cells up together with No. 20 magnet wire or No. 18 bell wire, but use No. 14 or even No. 12 rubber covered wire, and, lastly, see that spark coil is kept dry.

Railways, some how or other, seem to be at logger-heads with the public or their representatives, as shown lately in Toronto and Montreal. Now, were they to give the public one moment's consideration in some affairs, they might secure some champions from the ranks of the people; for instance, around Mountain street, in this city, the Grand Trunk railway manage to make night hideous with their shunting, as do the C. P. R. at Westmount (suburb). It would seem an easy matter to get a branch off the trolley of the Montreal street railway, which is adjacent to both railways mentioned, and use an electric locomotive to do the shunting. The stentorian puffs and whizzing of steam being absent, the nuisance would be minimized to such an extent as to come within the bounds of toleration.

There are certain electricians who "kick" at U. S. alien labor law allowing U. S. men to come into Canada and do electrical work, when they cannot do likewise across the border. Might one question be put to the kickers: Do they subscribe to the CANADIAN ELECTRICAL NEWS at $1 (only) per annum, or do they subscribe, and generally at higher expense, to alien electrical periodicals in the U.S.A.? There is no harm in their doing both, but "Canada first" should be the motto in this argument as well as in the other.

The old time controversy of direct vs. alternating for interior illumination in large cities seems to be pretty well settled in favor of the latter, although one of the arguments brought forward at the time by advocates of the former, viz., the danger of breakdown in transformers, permitting the high pressure current to enter buildings, is bearing abundant fruit at present. Of course, there has been considerable lightning about, which may have caused some of the trouble, but the half will never be known, as companies, and rightly so, frown down any publicity of such events whenever possible.

Has not the demand for high efficiency and low priced transformers got something to do with this state of affairs? In the past far less of this sort of thing was met with, although it is equally true that many more transformers are now in use. Whatever may be the cause, central stations should ferret it out, or some suitable device to prevent disaster when such an event does happen, as many of the general public are beginning to think that gunpowder and electric light (especially during thunder) are equally dangerous to have around. The underwriters, who make numerous regulations, should see that Tom Jones' house, wired in 1886, is not fed from the same transformer as is feeding Bill Smith's house, wired in 1900, as in so doing they bring the latter high risk down to the former low level.

All that the companies care is that the installation is safe "at the date when connected." True, they have inspectors, who no doubt condemn such faulty "fittings" as they may come across, but it is not reasonable to suppose that they cut the mains (where there is no main switch) and "ring out" the various residences for "grounds." A company's inspector may report "lack of main switch,' and the tenant retort "looking for a job" ;it would be otherwise, however, if from the official underwriters' inspector. The insurance companies lose most, and yet seem to fear the expense of employing an electrical expert whose sole duty it would be to coach and confer with the usual routine inspectors of the underwriters. It has got to come some day, and the time is ripe now. So far indoor wiring has had all of the attention, such as it is; there is evidence, however, that a little attention to outdoor wiring, transformers, grouping of buildings, etc., of this nature would not be amiss.

## SPARKS.

The British Columbia Electric Railway Company are building an extension of their road from New Westminster to Sapperton.

The Hamilton Gasoline Engine & Automobile Company, Limited, has been incorporated, with a capital of $40,000 and head office in Hamilton.

The Cape Breton Tramway & Electric Company, with a capital of $500,000, have decided to build an electric railway connecting Sydney, Glace Bay, and Sydney Mines.

The Central Electric Street Railway Company have made a proposition to build a street railway along the streets of Sarnia. The Sarnia Street Railway Company have asked a similar franchise.

A by-law to raise $100,000 to purchase the electric light and gas plants of the Brockville Light & Power Company was sanctioned by the ratepayers recently. A vote as to whether the plant should be under the control of the town council or five commissioners resulted in favor of the latter.

The Penman Manufacturing Company, Paris, Ont., are installing a new electric plant in their No. 1 mill, and have purchased a 55 kilowatt multipolar generator from the Canadian General Electric Company for the purpose. This is the fourth plant the Canadian General Electric Company have supplied to the Penman Company for their different mills.

The Electrical Construction Company, of London, Limited, have received orders from G. E. Matthews, Montreal, Que., for one 6 h.p. motor; Clark, Pennock & Co., London, Ont., one 8 h.p. bipolar motor; Malloch & Co., London, Ont., three 6 h.p. elevator motors; Burnett & Sons, London, Ont., one 8 h. p hoisting motor, with controller.

The Mail Job Printing Company., Toronto, have placed their order for six slow speed press motors with the Electrical Construction Company of London, Limited. This order, together with the three recently placed for the same purpose with the Salvation Army, Toronto, and two with the W. J. Gage Company, Toronto, show the general favor with which these special slow speed motors are regarded.

**The Canadian Electrical Association is ten years old. Will you assist to celebrate the event at Kingston on the 29th, 30th and 31st inst.**

# ENGINEERING and MECHANICS

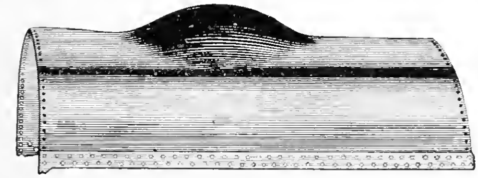
## ANNUAL CONVENTION OF STATIONARY ENGINEERS.

The annual convention of the Canadian Association of Stationary Engineers will be held in Toronto commencing on Tuesday, August 28th, at 11 o'clock a. m. Arrangements have been made for an interesting programme, including papers on "Chimneys" and "Injectors" by Messrs. E. J. Philip and A. E. Edkins. Mr. H. E. Terry is chairman of the local committee, the members of which are working energetically to make the convention even more successful than any held heretofore. As the Toronto Exhibition will be in progress, reduced railway fares from all parts will be obtainable, and there is reason to expect a large attendance of members and visitors. The meeting place will be Engineers' Hall, 61 Victoria street. Particulars regarding the convention will be gladly furnished by Mr. A. M. Wickens, executive secretary, 280 Berkeley street.

## THE EFFECT OF OIL IN BOILERS.*

We often referred to the fact that the presence of grease or any of the animal oils in steam boilers is almost certain to cause trouble. Our illustration gives a better idea of the effect produced than pages of verbal description possibly could. It is from a photograph and is no wise exaggerated.

The boiler from which the plate shown in the cut was taken was a nearly new one. It was made of a well-known brand of mild steel, and that it was admirably adapted to the purpose for which it was used, is proved by its stretching as it did without rupture. The dimensions of bulge shown are four feet lengthwise of the boiler, three feet girthwise and nine inches deep. The metal, originally 5-16 of an inch thick, drew down to 1/8 inch in



EFFECT OF OIL IN BOILERS.

thickness at the lowest point of the "bag" without the slightest indication of fracture.

The circumstances under which the bulge occurred may best be described in the words of the inspector who examined the boiler, and are as follows:

"Last Tuesday morning I was called in great haste to the——— works. Upon arrival I found one of the boilers badly bulged, and with twenty pounds of steam up. I could give no explanation until I had thoroughly examined the internal parts of the boiler. I gave directions for cooling the boiler and ordered top man-hole plate to be loosened, but not to be taken out until my arrival in the afternoon, that I might see everything undisturbed. This was done. On my arrival I took out the man-hole plates in top of shell and front head * * * and made an examination."

"I found the boiler had been cleaned from preceding Sunday, and at that time a gallon or more of black oil had been thrown into it. Monday morning the boiler was fired up and was run through the day at a pressure of 90 pounds per square inch. At six o'clock Monday night the engine was stopped, the drafts were closed, and no more firing was done until nine o'clock. Upon going to fire up at this time, the bulge was observed. From six to nine o'clock a pressure of only 40 pounds was carried.

"Upon examination I found the entire boiler saturated with this oil."

This is almost certain to be the result of putting grease into a steam boiler. It settles down on the fire-sheets, when the draft is closed, and the circulation of water nearly stops, and prevents contact between the plates and the water. As a consequence, the plates over the fire become overheated; and under such circumstances a very slight steam-pressure is sufficient to bag the sheets. Unless the boiler is made of very good material, the plate is very apt to be fractured, and explosion is likely to occur.

When oil is used to remove scale from steam-boilers, too much care cannot be exercised to make sure that it is free from grease or animal oil. Nothing but pure mineral oil should be used. Crude petrolium is one thing; black oil, which may mean almost anything, is very likely to be something quite different.

The action of grease in a boiler is peculiar, but not more so than we might expect. It does not dissolve in the water nor does it decompose, neither does it remain on top of the water, but it seems to form itself into what may be described as "slugs," which at first seem to be slightly lighter than the water, of just such a gravity, in fact that the circulation of water carries them about at will. After a short season of boiling, these "slugs" or suspended drops seem to acquire a certain degree of "stickiness," so that when they come in contact with shell and flues of the boiler, they begin to adhere thereto. Then under the action of heat they begin the process of "varnishing" the interior of the boiler. The thinnest possible coating of this varnish is sufficient to bring about overheating of the plates, as we have found repeatedly in our experience. We emphasize the point that it is not necessary to have a coating of grease of any appreciable thickness to cause overheating and bagging of plates and leaking at seams.

The time when damage is most likely to occur is after the fires are banked, for then, the formation of steam being checked, the circulation of water stops and the grease thus has an opportunity to settle on the bottom of the boiler and prevent contact of the water with the fire-sheets. Under these circumstances, a very low degree of heat in the furnace is sufficient to overheat the plates to such an extent that bulging is sure to occur. When the facts are understood, it will be found quite unnecessary to attribute the damage to low water.

Thie accident also serves to illustrate the perfection to which the manufacture of steel or boiler plates has attained. It would be an extraordinarily good quality of iron that would stand such a test without fracture.

From the eighth edition of "Helios," published by the Heine Safety Boiler Company, and reproduced by permission.

## TRADE NOTES.

Messrs. Geo. May & Sons, Ottawa, have placed an order with the Electrical Construction Co. of London, Ltd., for a 5 h. p. motor.

The Goldie & McCullough Company, of Galt, Ont., have installed a 10 h. p. "Model" gasoline engine at the Royal Military College, Kingston.

C. W. Thompson, of the Napanee Mills Paper Company, Newburg, Ont., is replacing his arc lighting plant with a complete direct current incandescent system, supplied by the Royal Electric Company.

Messrs. Jack & Robertson, of Montreal, have recently been appointed Montreal sales agents for the Robb Engineering Company, of Amherst, N.S., manufacturers of the celebrated "Robb" engines, "Mumford" boilers, feed water heaters, etc.

The Volta Electric Storage Company, of Hamilton, Ont., is installing a 120 k. w., 110 volt, bi-polar direct current generator and a 25 k. w. direct current 250 volt multipolar generator for charging batteries and for testing purposes, purchased from the Royal Electric Company.

Mr. R. E. T. Pringle, dealer in electrical apparatus and supplies, Montreal, is about to open an establishment at 72 Prince William street, St. John, N. B. This branch will be in charge of Mr. Geo. C. Rough, who has been sales manager at Montreal for Mr. Pringle for the past four years.

The Dominion Government has placed an order with the Royal Electric Company, of Montreal, for a 30 k. w. direct current multipolar generator, direct connected to a Robb-Armstrong engine, together with a marble switchboard, and arc and incandescent lamps to light the docks at Sorel, P. Q.

The following are a few of the orders received by the Electrical Construction Co. of London, Ltd., during the last month: Messrs. Lamb & Bate, Stratford, 3 h. p. motor; Chas. Allan, Ingersoll, 2 h. p. motor; Mitchell & Co., Ingersoll, 3 h. p. motor; Thos. A. Cooley, Peterborough, 1 h. p. motor; G. E. Matthews, Montreal, two 2 h. p. motors.

The Electrical Construction Co., Ltd., of London, recently received the following orders from their agents in Winnipeg: Two one h. p. motors, 2 h. p. motor, 3 h. p. motor, 4 h. p. motor, 8 h. p. motor, 30 light dynamo. Messrs. Hoffmeister Bros., Vancouver, B. C., have placed an order for a 3 h. p. multipolar motor with the Electrical Construction Co. of London Ltd. The Georgian Bay Navigation Co., Collingwood, have placed an order with the same company for the supply of a 150 light dynamo, including the complete wiring of their boat Britannic.

## QUESTIONS AND ANSWERS.

A Montreal correspondent asks: "What are the changes, if any, necessary in the connections of (a) a series, (b) a shunt, (c) a compound wound dynamo, in order to keep the polarity of the circuits the same, when the dynamo is running in the opposite direction to its original rotation?

ANSWER: If it is necessary to change the direction of rotation of any dynamo, the easiest way to maintain the same polarity in the circuit is to reverse the terminals of the circuit at the terminals of the dynamo. This would apply to any description of dynamo.

## SPARKS.

The Herald Publishing Company, Montreal, have purchased a 30 h.p. 250 volt motor from the Canadian General Electric Company.

The Canadian General Electric Company have sold the Guelph Street Railway Company one of their standard General Electric 1,200 two motor railway equipments, complete with two k. 21 controllers.

The Plessisville Electric Company, of Plessisville, Ont., have recently installed a 120 k.w. single phase alternator purchased from the Canadian General Electric Company.

The Ottawa, Brockville and New York Railway Company propose, it is said, transmitting electric power to the town of Brockville. Messrs. Geo. E. Kidd and James Stratton, of Ottawa, are interested.

**Those who attend the Convention of the Canadian Electrical Association at Kingston on the last three days of this month will see. In the best and most comfortable manner and in excellent company, the beauties of the famous Thousand Islands.**

## SPARKS.

The electric light plant at Danville, Que., was recently sold at auction to Thomas Crockett for $6,500.

The Paisley Electric Light Company have purchased a 1,200 light S. K. C. generator from the Royal Electric Company.

The Almonte Electric Light Company have not yet been successful in securing a renewal contract for street lighting in the town of Almonte, Ont.

The electric light plant at Revelstoke, B. C., may be purchased by the corporation. Col. Tracey, C. E., of Vancouver, recently valued the plant.

The Royal Electric Company, of Montreal, have been given a contract for 20 years for street and commercial lighting within the corporation of St. Laurent, Que.

The Ballard Electric Co., Toronto, have recently sent out a neatly printed catalogue of 100 pages, containing numerous illustrations and prices of electrical supplies.

Owing to some disagreement, the town of Springhill, N. S., is reported to be in darkness, but the authorities are making an effort to install a new electric light plant.

The town council of Yarmouth, N. S., have accepted the offer of the Yarmouth Gas Light Company to light the streets of the town for one year, at the price of $3,500.

The Canadian General Electric Company have just completed the installation of one of their standard 60 kilowatt single phase alternators for the Leamington Electric Light Company.

The Fensom Elevator Company have secured the contract for the erection of an electric elevator to be operated in connection with the rapid handling of mail matter at the Union Station, Toronto.

The Canadian General Electric Company have recently received an order from the Lake Superior Power Company, Sault Ste. Marie, for a 400 h.p. 500 volt direct current dynamo, with switch-board complete.

The Renfrew Electric Company, of Renfrew, Ont., held its first semi-annual meeting recently, and after only six months of corporate existence, declared a dividend on the basis of 6 per cent. per annum.

The Canadian Electric & Water Power Co., Limited, of Perth, have purchased a water power at Glen Tay, three miles from Perth, on the Tay River, where they intend installing an electric plant as an auxiliary to their present plant.

The Canadian Manufacturer has recently published a special number, in which is printed in detail the Canadian, United States, British and Newfoundland customs tariffs. This number will no doubt be found very useful for reference.

Almonte, Ont., town council voted down a resolution to accept the offer of the Almonte Electric Company for a ten years' contract for street lighting until midnight at $55 per 2,000 c. p. lamp per annum. It is likely that the corporation will purchase a municipal plant.

Mr. J. P. Graves has submitted a proposition to acquire the waterworks and electric light plants at Grand Forks, B. C., for 25 years. Mr. Graves offers to pay the corporation $70,000 and to expend $30,000 in improving the plants. He has also submitted a proposition for the construction of an electric railway.

The Canadian Woollen Mills Company, of Carleton Place, Ont., have just purchased from the Canadian General Electric Company an electric plant for transmitting power and light to their various mills. The order consists of one 100 h.p. multipolar 500 volt generator, one 75 h.p. multipolar 500 volt motor, and all the necessary switch-board apparatus.

The American Alkali Company, of Saulte Ste. Marie, Ont., have recently put into operation the two 225 k.w. 200 volt generators purchased from the Canadian General Electric Company. These generators are direct connected to water-wheels operating at a speed of 200 revolutions per minute. The process used by the Alkali Company is one of the most interesting in the country.

Mr. J. A. Valois, manager of the Chambly Electric Company of Montreal, in company with Mr. J. G. Petit Clair, foreman of the same company, have within the last month visited New York, Philadelphia and Chicago, where they purchased a few thousand dollars worth of electric light and electro medical apparatus. It is rumored that their company have a large contract in view.

The Canadian General Electric Company have received an order from the Aylmer Electric Manufacturing Company, Aylmer, Ont., for one of their standard 2,000 light revolving field monocyclic alternators, with panels. This is a type of machine which will be very much sought after in the future where it is desired to furnish electric power to polyphase motors of all sizes and still maintain the simplicity of single phase distribution for lighting.

The Rev. Sisters of St. Anne, inaugurated about the end of July their new incandescent lighting plant installed at their convent at Lachine, P. Q. The plant was put in by the Chambly Electric Company, of Montreal. Mr. J. A. Valois, manager of that company, at first signed a contract for the installation of a few lamps, but the sisters after seeing the advantages of electric light over coal oil lamps, decided to install an 800 light plant.

It is said that a company is being formed to manufacture incandescent coal oil lamps after a model invented by Mr. V. L. Emerson, of Ottawa. The incandescence is created by blowing a thin stream of coal oil in a spray over a film shaped liked the auer light burner. The result is said to be a light of much higher brilliancy than an ordinary sixteen c. p. electric light, while the cost is claimed to be but one-tenth of a cent per hour.

The city council of St. John, N. B., recently invited tenders for electric street lighting. The Carleton Electric Light & Power Company tendered to light the west side of the city at $105 per light per year. The St. John Railway Company offered to supply 90 lights for the Portland side at $75 per light per year, and to light the east side of the city for $85 per light per year. The Board of Public Safety have recommended that the council accept the tender of the St. John Railway Company.

Mr. Roderick J. Parke, consulting engineer, of Toronto, has been engaged by the municipal council of St. Marys, Ont., to prepare plans and specifications for the reorganization and combination of the present municipal arc lighting plant and the incandescent lighting plant recently acquired by the corporation from the Reesor Company. A new power station will be erected and a completely new engine and boiler plant will be purchased and installed. Work will be commenced as soon as possible.

The construction of the Crocker improved turbine is well shown in the fourth edition of the Jenckes Machine Company's water wheel catalogue. The various illustrations pertaining to the Crocker wheel show the adaptability of the Crocker turbine to varying requirements and local conditions. The tables of horse powers, which are guaranteed to be substantially correct, have been extended from 40 feet to 100 feet head. The figures are given for any wheel from 15 to 55 inches. There are also other valuable tables, which evidently have been prepared to meet the needs of the practical man and to facilitate the calculations and estimates required in connection with water wheel work. Diagrams of the principal methods of setting have also been inserted.

The Niagara, St. Catharines, & Toronto Railway Company, of St. Catharines, have just placed and order with the Canadian General Electric Company for two 300 kilowatt rotary converters, together with switch-board panels and high potential transformers of the oil cooled type complete. The transformers for this installation are very special in their construction, each having a primary connection for 2,200 volts, 11,000 volts, 22,000 volts, with secondaries of 375 volts. Total capacity of the six transformers will be 800 horse-power. The railway has already commenced operations in a temporary way until such time as they can procure power, and from the business being done there can be no doubt that this will be one of the most successful electric railways in Canada.

A wave motor is being built at Atlantic City by the Atlantic Wave Motor & Power Company, of Philadelphia, the object, of course, being to utilize the rise and fall of the sea to generate electric power. Henry C. Essington, the inventor of the machine, describes it as follows: "A ball twelve feet in diameter, on a revolving shaft with two yokes of solid cast steel weighing 850 pounds each, attached to a solid rocker arm or segment weighing 2,010 pounds, with a tensile strength of 60,000 pounds to the square inch. The whole attached to a twelve-foot revolving turntable which will hold the machinery, and to accommodate itself, and oscillates in accord with all the changes of the wind or current, the rise and fall of the tide, waves motion and swell of the ocean. The ball in riding the waves will be submerged two feet, and revolve on the axle or shaft continuously from the incoming waves, thereby relieving the strain from the machinery. We obtain direct power by discharging the water into the bottom of the receiver from the pump supplying the turbine wheel from an outlet which is placed on the bottom of the receiver. This receiver will act as an air chamber to a pump, and will fill the other part of the receiver with compressed air, which will force the water against the turbine."

## SPARKS.

The Canadian General Electric Company are just completing the installation of one of their 300 k.w. monocyclic alternators for the Winnipeg Street Railway Company.

The members of the Toronto Railway Electrical and Mechanical Benefit Association held their annual excursion to St. Catharines a fortnight ago. About 500 persons enjoyed the outing.

The Canadian General Electric Company are supplying the Tagona Water and Light Company with two 35 light 6.8 ampere arc dynamos, complete with lamp. This plant is to be used for lighting docks, etc., at Michipicoton.

The Volta Electric Storage Company, Limited, of Hamilton, is installing a battery switch-board for Mr. W. E. H. Massey, at his farm at East Toronto. This switch-board is being built by the Royal Electric Company.

The Central Peat Company, Welland, Ont., have placed an order with the Electrical Construction Company, of London, Limited, for one 25 h.p. multipolar generator, and one 15 h.p., one 10 h.p., and one 5 h.p. multipolar motors, to operate their works at Welland.

The Galt Gas Light Company, of Galt, Ont., have ordered from the Royal Electric Company a 100 k.w. S.K.C. generator, with switch-board and exciter, also a switch-board for their present single phase alternator and one for their arc lighting system.

A project is said to be under consideration involving the construction of an electric railway from Three Rivers to Grand Mere, Que.

The Electrical Construction Company, of London, Limited, are having a great demand for machines from Winnipeg. They have received a further order from the Stuart-Arbuthnot Machine Company for one 16 h.p. multipolar motor, one 15 h.p. multipolar moter, and one 8 h.p. bipolar motor.

Messrs. R. & W. Conroy, Ottawa, Ont., are installing a large transmission plant at Deschenes Falls, P. Q., for the purpose of furnishing electric power to the E. B. Eddy Company and others. Their electrical equipment consists of two 800 kilowatt revolving field three phase generators, wound for a potential of 10,500 volts E.M.F.; the current is transmitted a distance of 6 miles to Hull, where it is transformed to a potential of 400 volts through step-down transformers of the oil cooled type, all the electrical apparatus being furnished by the Canadian General Electric Company.

The McLean Publishing Company, Toronto, have ordered from the Electrical Construction Company, of London, Limited, one slow speed press motor to be direct belted to printing press.

## SPARKS.

The electric light plant at Farnham, Que., will be sold by the sheriff.

Incorporation has been granted to the Renfrew Power Company, Limited, with a capital of $50,000.

The McLachlan Electric & Gasoline Motor Company have removed to new premises at 115 Bay street, Toronto.

The premises of McDonald Bros., electrical contractors, Winnipeg, Man., were recently damaged by fire to the extent of $5,000.

The Leamington Electric Light Company have just put in a new 1,500 light dynamo, furnished by the Canadian General Electric Company.

A company has been formed at Ottawa for the manufacture of automobiles. Messrs. John Sutherland and J. Carling Kelly are the promoters.

W. H. Meldrum, of Peterboro, has just recently installed a 20 h.p. three phase induction motor purchased from the Canadian General Electric Company.

Wm. Clark, a lineman in the employ of the Winnipeg Street Railway Company, recently came in contact with a live wire and was electrocuted.

The Canadian General Electric Company have recently installed one of their standard 120 k.w. single phase alternators for the Chesley Electric Light Company.

The ratepayers of Cannington, Ont., have voted against the purchase of the Dobson electric light plant which it was proposed to operate as a municipal concern.

The Shawinigan Water & Power Company, of Montreal, have purchased a 75 k.w. multipolar 125 volt generator from the Canadian General Electric Company.

The Montreal Automobile Company have made application for a Dominion charter, with a capitalization of $250,000. Messrs. Emile Lepage and J. W. Faucher are interested.

The Canadian General Electric Company are installing one of their standard 150 kilowatt three phase revolving field alternators for the Hanover Electric Light Company. The order covers the furnishing of several induction motors and a complete installation of series alternating arc lamps, with constant current automatic regulating transformer.

The council of Newmarket, Ont., are in favor of spending about $10,000 to increase the electric light and water works plants, and the ratepayers will be asked to sanction the outlay.

The Hamilton Motor Company, of Peterborough, Ont., has been incorporated, to manufacture electric and gasoline motors. The directors include T. A. Colley, W. J. Hamilton and J. W. Bennett.

The ratepayers of Dartmouth, N. S., recently rejected a recommendation of the town council that the plant and franchise of the Dartmouth Electric Light Company be purchased for the sum of $25,000.

A company has been formed, known as the Gasoline Engine Company of Toronto Junction, to manufacture gasoline engines. Recently authority was obtained to increase the capital stock to $50,000.

The ratepayers of Bracebridge, Ont., are evidently progressive, as by a vote of 72 to 5 they expressed themselves in favor of raising the sum of $27,000 for the purpose of extending and improving the electric light plant.

The Richelieu & Ontario Navigation Company have equipped two of their new boats with 30 kilowatt direct current generators direct driven by "Ideal" engines, all of which were purchased by the Canadian General Electric Company.

The corporation at Hespeler, Ont., have purchased the electric light plant of J. S. Shantz for the sum of $2,800, which does not include the boiler and engine. The town will install an incandescent system in connection with the present arc plant.

The Canadia General Electric Company are supplying Mr. J.A. Williams, of Dawson City, Alaska, with a complete electric plant, consisting of one standard 200 k.w. revolving filed three phase alternator, on 50 h.p. and one 10 h.p. induction motor, together with all transformers and electrical supplies required. This plant will be in operation very shortly and the indications are that Mr. Williams' enterprise will be a very successful one.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. SEPTEMBER, 1900 No. 9.

## MR. D. E. BLAIR.

THOSE who attended the recent convention of the Canadian Electrical Association will recognize in the accompanying portrait the features of Mr. D. E. Blair, B. Sc., the author of that interesting paper pertaining to the operation of the electric railway in the city of Quebec. Although only twenty-three years of age, Mr. Blair is well versed on the subject of electric railway operation. He graduated from the High School in the year 1893, when he entered the Science Department of McGill University, graduating with the degree of Bachelor of Science in the spring of 1897. In August of that year he was engaged as assistant electrician for the Quebec District Railway Company, and in the following year became chief electrician. In the fall of 1898 this company was amalgamated with the Quebec, Montmorency & Charlevoix Railway Company and the Montmorency Power Company under the name of the Quebec Railway, Light & Power Company, and since that time Mr. Blair has acted in the capacity of chief electrician of the railway division of the amalgamated interests. His paper, read before the Canadian Electrical Association, and which appears in this issue, is one of exceptional value, and was much appreciated by the members.

MR. D. E. BLAIR.

## CHAMBLY POWER FOR MONTREAL STREET RAILWAY.

THE Montreal Street Railway Company have entered into a contract with the Chambly Power Company under which the latter agrees to supply the former with 5,000 h.p. continuous current, day and night, every day in the week, for twenty-three years, at $25 per h.p. per annum. The arrangement is no doubt in the interest of the street railway company, as it saves a large outlay for additional plant, in the shape of engines, boilers, machinery, buildings, etc., their present power plant being fully loaded. Again, it is good for the Chambly Company, who run by water power, use large units, and are really in need of a load, more especially if the contemplated new dam is gone on with.

There was opposition to the contract by some of the directors of the Street Railway Company, but, luckily, the manager, Mr. Wanklyn, is a practical man, thoroughly up in the business, and he managed to get a proper view of things taken, and the scheme was ratified.

The contract aggregates, in twenty-three years, $2,875,000. At the meeting of the Street Railway Company, Mr. Wanklyn explained that at the present time the Montreal Street Railway was laboring under the disadvantage of not having any reserve of power. It would cost the company at least $650,000 to build the necessary reserve steam plant, and he considered the contract before the shareholders the most advantageous arrangement which they were able to make. On a winter's day at present the railway needed nearly 1,000 horse power, and he expected that in two years' time they would require another 5,000 horse power from the Shawinigan or any other company which could furnish it to the best advantage. Mr. Boas stated that the Shawinigan Company would put the power in at from $20 to $22 per horse power per year. To this Senator Forget remarked that as a director of the Shawinigan Company he was in a position to say that they were not ready to supply power. In answer to some questions, Mr. Wanklyn explained that it would take about 7,100 horse power alternating current at Chambly to deliver 5,000 continuous current to Montreal. The relative cost of the alternating and continuons currents is $25 to $32 per horse power. The Royal Electric Company had been contracted with to supply 500 horse power alternating current, as a temporary relief, for $35 per horse power, which was equivalent to $42 continuous current. Mr. James Ross, the vice-president of the company, thought the Street Railway Company was making an excellent bargain. He had visited different western cities, had seen all the latest improvements in electrical power, had gone over the works of the Niagara Company, which is getting $35 and $36 per horse for its power, and he had come to the conclusion that the Street Railway Company was making the best bargain possible.

The Wm. Sutton Compound Company, of Queen street east, Toronto, had an attractive display of engineers' supplies in the machinery hall at the Toronto Exhibition. They included boiler compound, lubricating oil, cotton waste, pipe covering, asbestos goods, etc. The company report a steadily increasing trade in these lines.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2299.



**Canadian Electrical Association.**

THE annual convention of the Association held in Kingston at the close of last month was, perhaps, quite as successful, all things considered, as could have been anticipated. The change in place and date of the meeting made necessary by the Ottawa fire, the absence of some of the members on vacation, and the necessary attendance of others at the Toronto Exhibition, were important factors militating against a good attendance and a successful meeting. Keeping in mind these drawbacks the attendance was satisfactory. The papers were of a high order, but in some instances evoked less discussion than their merits entitled them to. The late date at which the manuscripts reached the committee made it impossible to have the papers printed and distributed to the members in advance of the meeting. To this was largely due the lack of discussion, especially on some of the more highly technical papers. Authors would do well to remember that if their papers are to receive proper attention at these conventions they must be completed sufficiently in advance of the meetings to permit of their being carefully read and digested by the members. Seeing that an important object of most of the papers presented at meetings of this kind is to provoke discussion, and that the points brought out by the discussion are in many instances quite as valuable as those contained in the paper itself, every effort should be made to ensure as full discussion as possible by the members of the papers which may be presented at future conventions. To this end it is incumbent upon the Association to allow ample time for the preparation of papers, and upon those who may undertake their preparation to complete their task at least a month in advance of the meeting at which they are to be presented.

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In the President's address and the reports of the various committees there is to be found evidence of useful work acccomplished by the Association in the past, as well as a determination to broaden to the greatest possible extent the scope of its influence in the future for the development and protection of electrical interests in Canada. Special emphasis should be placed upon the value of its work in securing the legislation contained in the Conmee Bill, under which the interests of electric lighting companies in their relation to the municipalities are safeguarded. This measure has already proved of inestimable value to several companies whose property has, thanks to its provisions, recently been taken over by the municipalities at a fair valuation. Had this measure not been placed on the statute books, largely through the efforts of the Legislation Committee of the Canadian Electrical Association, these and all other private lighting companies would have been completely at the mercy of the municipalities. In view of what it has done for them, the Association has the strongest possible claim to the friendship and support of electric lighting companies in Ontario. All such companies should show their appreciation by becoming identified with the Association and its work. Mention was made at the Kingston convention that the Electric Light Association of the United States had recently sent out letters to lighting companies in Canada soliciting them to become members of that organization. Apart from the fact that membership in the National Association costs $25 per year, while in the Canadian Association the cost is only the nominal fee of $3 per year, the Canadian organization can benefit the electric lighting companies of Canada in many directions—notably as regards legislation, municipal, provincial or federal—to a much greater degree than could an alien society. An important concession was obtained last year by the Association from the Inland Revenue department of the Dominion government by which in future the charge for reinspection of detective meters will be only fifty cents.

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There is ample scope in these and other directions for useful effort by the Association in behalf of the electrical interests—not to speak of the benefits accruing from the reading and discussion of valuable papers such as are presented at the annual conventions. This year a new departure was made by inviting manufacturers and dealers in electrical and kindred supplies to send exhibits to the convention, necessary space, current and labor for the purpose being provided without charge by the city council and local electric companies of Kingston. Doubtless this will prove to be an interesting feature of future conventions.

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Too much cannot be said in praise of fhe cordial hospitality extended by the Mayor and Corporation, the local electrical companies and the citizens of Kingston to the members of the Association in attendance at the convention. The decision to hold next year's convention at Ottawa and the re-election of the President and other executive officers will no doubt meet with the approval of the entire membership. Steps are to be taken to materially increase, during the coming year, the already large membership of the Association, and to push vigorously forward all departments of its work.

# CANADIAN ELECTRICAL ASSOCIATION

## PROCEEDINGS OF THE TENTH CONVENTION

THE Tenth Annual Convention of the Canadian Electrical Association was held in the City Hall, Kingston, Ont., on Wednesday, Thursday and Friday, August 29th, 30th and 31st. The first session opened at 10 a.m., the president of the Association, Mr. A. A. Dion, of Ottawa, being in the chair.

The following members were in attendance :

W. H. Warrington, A. M. Wickens, T. F. Dryden, J. A. Kammerer, A. C. McDonald, J. J. Wright, H. Gearing, A. B. Smith, J. Raymond, E. B. Biggar, C. H. Mortimer, Toronto ; F. H. Leonard, jr., W. J. Plews, W. B. Powell, Wm. H. Browne, P. G. Gossler, H. O. Edwards, A. L. Mudge, N. C. Ross, Cecil Doutre, Wm. H. Winter, F. Wilson Fairman, K. B. Thornton, A. G. Grier, R. M. Wilson, Geo. H. Olney, L. A. Herdt, Thomas Rogers, D. Sleeth, Ed. Brown, J. P. Thomson, R. E. T. Pringle, R. S. Kelsch, A. C. McDonald, Montreal ; A. A. Dion, W. G. Bradley, Wm. Ahearn, jr., J. M. Leamy, W. S. Hodgins, D. R. Street, Ottawa ; H. R. Leyden, Gordon J. Henderson, F. W. Martin, Wm. A. Turbayne, Hamilton ; A. A. Folger, E. Moore, Geo. H. Dickson, J. Halliday, F. Simmons, E. Ashley, R. White, R. Boyd, jr., H. C. Nickle, I. H. Breck, Thomas Donnelly, Kingston ; A. L. Briethaupt, J. E. Bilger, Berlin, Ont.; W. W. Williams, Geo. Shand, Sarnia, Ont.; B. F. Reesor, Lindsay, Ont.; J. F. H. Wyse, Brantford, Ont.; E. E. Cary, George A. Powell, St. Catharines, Ont.; J. W. Purcell. Walkerville, Ont.; John Yule, Guelph, Ont.; A. Sangster, Sherbrooke, Que.; D. E. Blair, Edward Slade, Quebec, Que.; L. A. Somers, Halifax, N.S.; P. H. Houer and Geo. M. de Ginther, New York.

The President called the convention to order and stated that the first item on the programme was the address of welcome from the Mayor and Aldermen of the city of Kingston. He said : I have much pleasure in introducing the mayor and some of the members of the city council who have been kind enough to come and greet us this morning.

Mayor J. A. Minnes, on rising to speak, was greeted with applause, and said : Mr. President and Gentlemen of the Canadian Electrical Association : It gives me, on behalf of my colleagues of the city council and the citizens of Kingston generally, the greatest of pleasure to extend to you a most cordial and hearty welcome to this good old historic city. Let me assure you, we appreciate the honor you have done this city and done us in holding this convention here. I trust your deliberations may be productive of very much good to your Association, that your visit may be a very pleasant one, and that you will be able to carry away with you a very pleasant recollection of your stay in Kingston. Referring more especially to the object of your gathering, let me say that, in my mind, it is fraught with the greatest possible interest to the welfare of mankind. There is no subject of more vital importance or of greater moment than the study of that subtle and silent force with which your labors are connected. Of the abstruse quality of that power, what it is, whence it comes and whither it goes, I will not attempt to speak, but let me congratulate you, Mr. President and Gentlemen, on the splendid strides and rapid advancement electricity has made, more especially in its application to the good of humanity. This may truly be said to be a progressive age, that the object of all our energy is to make the powers of nature, seen and unseen, minister to the wants of man, his progress, welfare and happiness. In the industrial application of the electrical current we have reached a position never before dreamed of by any previous generation. It is an important factor in our transportation, it moves the great wheels of commerce, it gives the traveller the light, and affords light, heat and comfort to all men. In the Roentgen ray the unseen parts of the body are brought to view, thereby proving a valuable adjunct to medical sciences. In fact, in the whole complex system of modern civilization it proves an important factor. I congratulate you that your labors are in such a field. I trust that through your deliberations benefits heretofore undiscovered may be brought forth, and I trust that your convention in Kingston may prove of very much good to your Association and to mankind in general. I extend to you the freedom of the city. Accept it from my hands, and I trust your stay will be a most pleasant one. (Applause.)

Ald. Donnelly, in following the Mayor, said : As a member of the City Council, I desire to supplement the remarks of our Mayor in regard to the kind invitation that he has given to you this morning. We cannot offer you any of the very great advantages that you will find in the larger cities in Canada, but we point with a great deal of pride to the historical record of Kingston and to the physical advantages which you see on every hand. Kingston is beautifully situated. You will find it of great interest to visit our educational institutions, to notice the great harbor that we have here, boating facilities, the works that the Militia Department in the old days have erected here for the defence of the city, and we trust you will find enough interest in the city to warrant your coming back here in the near future. At any rate, we will endeavor to do our best to make it as pleasant for you as we possibly can. As the Mayor has very truly said, yours is a very noble vocation indeed. To harness and control the powers of electricity is something that must be of great interest to mankind ; and you in your deliberations and advice one with the other will be able greatly to assist along the lines of this work. I can assure you that anyone who notices what vast strides electricity has made in the last few years cannot help but be amazed when they notice it. Why, it is only the other day, looking at some of the reports of the United States, I noticed that at the present time the electrical plants of the United States—somewhat over 3000 plants represent a value of three hundred millions of dollars. That is a wonderful record, indeed, when we take into consideration that it has only arisen in the past few years, you might say. As one of the Council of the city, I will do all that I can to make your visit a pleasant one. The Mayor has told us that your labors have been of great advantage to mankind. You have, it seems to me, in a greater degree than any other body of men carried out the scriptural injunction which we find very early in the bible, when the Lord said "Let there be light, and there was light." (Applause). I hope and trust that your deliberations will be of great benefit to yourselves and to mankind, and I know they cannot help but result in all that is beneficial to electrical interests on this continent.

The President : I have much pleasure in calling upon the President of the Board of Trade to address a few words to you.

Mr. E. J. B. Pense : Mr. President, I can assure you, on behalf of the mercantile interests of Kingston, that we heartily endorse the welcome addressed to you by the Mayor and by Ald. Donnelly. I have read somewhere (I think it was in a patent medicine advertisement) that "electricity is life." We have not

fully realized it in the city of Kingston yet, because we have not got an electric light on every corner, but we hope next year to make some attempt at a municipal lighting system; at least, they are all talking that way. I may say, electricity has not been a very strong point in the city of Kingston, but there are points about the old city, and we who have fought for a number of years to get it the recognition it deserves, are very proud indeed to have your convention here, that the people of Ontario may say that the city is a little better than it looks. You will find in the city of Kingston, a city of 20,000 people, greater charities than is found in any other city of its size on the continent of America. You will also see fine churches. We are not given many gifts by rich men, but we have a great university and it is going to be much greater; instead of being Queen's College it is going to be Queen's University in all that a university implies. In three or four years I hope to see three or four stone buildings upon the campus of Queen's University, and among those buildings I am assured by Principal Grant will be one for the full equipment of an electrical plant. Our mining school, which has struggled along for a few years, is doing the best practical mining work on the continent of America, with the exception of the Michigan school, and they receive a straight grant of $45,000 a year. We are now equipping a laboratory which will be the best by far odds in practical mining in the whole Dominion of Canada; and I may say to you that it recognizes the generosity with which science is looked upon by all classes and all countries, that nearly every machine in that mining laboratory is a gift from manufacturers, and chiefly from the United States. I can assure you, gentlemen, that although the mercantile interests of Kingston are not very strong, they have the reputation, as you know, of being solid, and that Kingston, while it is not large, is honest to the core, and the merchants of Kingston will reach towards you the glad hand and hope that you will go away from Kingston not only having had a pleasant time, but with a better opinion of its social and business qualities. (Applause).

The President: Mr. Mayor and Gentlemen of the city of Kingston: It is not my purpose to detain you here to listen to a speech of mine, but I desire on behalf of the Canadian Electrical Association to tender to you our very warm thanks for the kindness which you have shown us this morning. We are indebted to you, gentlemen, for coming here to greet us, and for the very kind words of welcome which you have uttered. We are indebted to you in a special manner because I know of no city where the previous conventions of this Association have been held where the municipality has taken such pains to show their hospitality. You have given us the use of your beautiful municipal building, and through your kindness we are enjoying the comforts of this well appointed place. You have done more, sir, you have provided for us an excursion to which we look forward with pleasurable anticipations, and we cannot say too much to express the gratitude which we ought to feel for all you have done for us. When I look upon these beautiful buildings I think it is a privilege to be here. When I look upon the beautiful portraits of the past mayors which adorn the walls of the hall upstairs, when I look upon you, sir, I think it is a privilege for me to occupy this chair, if only for a few moments. We accept with very much pleasure the freedom of the city which you have offered us. We will be very happy to have you attend the sittings of this convention right along. I think by this afternoon the attendance will be very much larger, and you may hear something that will be interesting and profitable to you. The next item on the programme this morning is the reading of the President's address. It seems to be an established custom in this Association that the President should read an annual address. Were it not so I would not inflict upon you this formality, but profiting by the experience I have gained during my year of office, I have put together here a couple of suggestions which will be taken up later by the Association, and thus this address may result in some benefit to the Association.

PRESIDENT'S ADDRESS.

To the Members of the Canadian Electrical Association:

GENTLEMEN:—I extend to you a hearty welcome to this our tenth annual convention. I have looked forward with feelings of keen pleasure to this meeting, where it would be my privilege to greet many old friends, make new ones, and celebrate with them the tenth anniversary of our Association.

Each successive convention increases my faith in the value of our Society from the standpoint of our various business interests as well as that of education—and I trust that this meeting will be as fruitful of good results as any of the preceding nine.

I had cherished the hope of meeting you in my own city of Ottawa, but it had been ordained otherwise. The disastrous conflagration of April 26th which reduced to ashes a large portion of our Capital, rendering thousands homeless and destitute, and destroyed the greater part of the various electrical plants of the city, made it practically impossible to hold the convention as prearranged, and a postponement became necessary at first, and later, to my regret, a change of place.

Let me say here that the value of the friendships formed in this Association was exemplified in a touching manner by the many expressions of sympathy, the prompt and generous offers of assistance received from many of my fellow members.

A formal invitation having been received from the good city of Kingston to hold our 1900 meeting here, the executive committee unanimously decided to accept the proffered hospitality. When you consider the good things provided for our entertainment by the mayor and citizens of this city, and the completeness of the arrangements made by the local committee under the guidance of Mr. F. Simmons, you will agree with me that we have made no mistake in coming here, and that the thanks of this association are due to those who so zealously labored for our comfort and pleasure.

It is a source of gratification to me that our membership continues to increase notwithstanding that a considerable number of members drop out of the association every year. We should put forth our best efforts to prevent, if possible, these annual lapses, and we should not rest satisfied until every electrical operating, manufacturing and supply company firm or individual is represented on the membership roll.

In this consideration I would submit to your earnest consideration whether it would not be well to introduce in our constitution a feature of company membership such as carried out by the National Electric Light Association of the United States in addition to the individual memberships, which could remain open to those who wished to avail themselves of them.

This might be a means of interesting in our work many companies who now take no part in it, although they all receive practical benefit from our labors.

You will be pleased to see by the report of the Secretary-Treasurer that our finances are in a sound and prosperous condition. The revenue up to May 31st last was about $130 in excess of that of the preceeding year, and the cash on hand for the same date was about $330, or more than double the amount on hand on the corresponding date last year. You will observe that this is due largely to the low cost, to the association, of the convention of 1899 as compared with that of 1898.

You will have submitted to you the reports of the various standing committees, and you will realize that all the work of the association is not done at the annual convention. Much has been done during recess and some important results have been obtained.

Those members who have freely given of their time and purse on committee work are entitled to the fullest expression of our appreciation and gratitude. The achievements of the legislative committee during the past year have been of incalculable value to the members of this association. Through the untiring, timely and well directed efforts of this committee the "Conmee Bill," which was in danger of being ruinously amended, was reaffirmed by the Legislature of Ontario, so that this law now bids fair to remain permanently on the Statute books of the province.

This is as it should be. No doubt a careful consideration of this measure has convinced our legislators of the justice of its principles and the wisdom of its provisions. The committee should be continued for the purpose of watching any legislation unjust to electrical interests which may be introduced in our legislatures, and I trust that such calls upon the companies interested which may be required to meet the necessary expenses will be promptly and cheerfully met.

Let me say to those who contributed to the expenses of this committee during past years, that they have received good and full value for their money. The work has been done efficiently and economically.

The report of the committee on meter inspection will show that it also has gained something for electric lighting companies in the reduction of certain inspection fees.

Other committee will report progress.

With regard to the committee on standardization of accounts, I would commend this work to your serious consideration.

If companies could agree on some general plan of distributing operating expenses, and would furnish their figures to some committee of this association, it would be possible to circulate among the members comparative statements of expenses, omitting names and amounts and giving percentages only, which would enable managers to test the economy of their management and apply the pruning knife where necessary. If all companies would agree to make their annual reports of revenue and expenses on the same basis, especially as regards interest, depreciation and charges of that nature, and publish their statements, it would be possible to ascertain the true percentage of net profits in each case, and this would tend to remove from the minds of municipal legislators the impression often prevailing that there are enor-

mous profits in public services such as electric lighting. In this way the ardor of advocates of municipal ownership might be tempered. At any rate it would have an educational value for the ratepayers.

The above considerations were suggested to me by a discussion on this subject which I had the privilege of hearing at the recent convention of the N. E. L. Association, who appointed a strong committee to deal with this question.

Letters have recently been received by electric light companies in Canada from the National Electric Light Association of the United States, urging such companies to join that association, (whose membership fee is $25 per year), in view of the important work being done by it for the benefit of electric light companies.

While that association, which has several Canadian companies on its membership roll, is to be commended for the work it is doing, I must remind Canadian electric light companies that their first duty is to the Canadian Electrical Association, whose work is of more immediate value to them, and which is in greater need of their co-operation and support.

The committee on papers is to be commended for the high character of the papers to be read and discussed at this meeting, and I desire to tender to the distinguished writers, who have given us so freely of their precious time, the thanks of the association. The range of subjects is such as to, I trust, please every member.

It is a matter for congratulation that the electrical industries in Canada generally continue to enjoy a reasonable amount of prosperity.

The past year has been marked by extraordinary activity and progress. Many new and extensive electrical works have been carried out, and everywhere there has been evidenced the greatest confidence in the future success of electrical undertakings. Water powers have been developed and utilized, and electric power transmitted to long distances. Large works and factories hitherto operated by steam have adopted the electric motor in large units. Some steam railways have been converted into trolley lines. Electric railways have been extended far out of cities, equipped with heavier rails, better rolling stock, larger generators, and more powerful motors, and higher speeds have prevailed.

Electric light and power stations have been enlarged and remodelled. In this particular field there has been a decided tendency to install generators of one kind only, and to supply all services therefrom, hence the increasing use of A. C. polyphase motors of the "induction" or "synchronous" type and A. C. arc lamps of the enclosed arc variety, either "series" or "constant potential."

The use of elecricity in mining has also received considerable development, and its application to the manufacture of calcium carbide is beginning to assume large proportions. The large number of small central station installations testifies to the increasing popularity of electric lighting and power. New isolated plants, some of them very considerable, were also very numerous. As a central station man I regret this, but I suppose the manufacturer is happy.

In the telegraph and telephone fields the past year has witnessed important extensions and improvements to existing systems.

Among the many important works of the year the following may be mentioned:

The great water power and electrical developments at Shawinigan Falls and other places on the river St. Maurice, Que.

The Jacques Cartier Water and Power Company, transmitting energy from the falls of the Jacques Cartier river to the city of Quebec for general light and power distribution.

The Canadian Electric Light and Power Company's transmission from the Chandiere Falls on the river of that name to the town of Levis, Que., for general distribution, with possible future extension to the city of Quebec, opposite, through submarine cables.

The Lunenburg Gas Company, transmitting 100 horse power 8 miles for distribution in Lunenburg, N.S.

The 14 mile transmission of the Lindsay Light, Heat and Power Company, into Lindsay, Ont., recently inaugurated.

Extensions of the Metropolitan Railway, of Toronto, to Newmarket, 30 miles distant. Extensions of the Ottawa electric railway to Britannia on the bay and to the Dominion rifle ranges.

The conversion of the steam railway from Quebec to St. Anne de Beaupre, some 30 miles.

The adoption by the Montreal Street Railway Company of electric power from Chambly, Que.

The installation of several thousand horse power of induction motors by the Dominion Cotton Company for their mills in Montreal, and by other factories in the same place.

The installation by the E. B. Eddy Company, of Hull, Que., of 1500 or more horse power of induction motors, and the building of a power house by Conroy Bros. at Deschenes, Que., five miles away, to supply the power at 10,000 volts.

The 500 horse power plant of the Soulanges canal used for operating the lock gates and for lighting the canal.

The 2,700 horse power generating water power plant of the Bronsons Company at Ottawa, supplying energy for the manufacture of calcium carbide to the Ottawa Carbide Company.

The extension of the government telegraph system in the Yukon district, 600 miles, and along the north shore of the lower St. Lawrence river, for 300 miles down to Labrador.

The substitution of storage batteries and dynamos for chemical batteries in the plants of the G. N. W. and C. P. R. telegraph companies at several places.

The complete renewal of the Bell Telephone Company's plant at Ottawa, introducing the "central energy" system. The complete reconstruction of their lines there and in other places, and the extension of their long distance system in all directions.

To this list, made mostly from memory, many other important works and undertakings could be added.

The pleasing features of all these undertakings, from an engineering point of view, is the generally scientific design and modern character of the apparatus and works.

I thank you for the confidence you reposed in me when you raised me to the presidency of this Association. I have conscientiously tried to further your interests during the year, and I am indebted to other officers and members of the Executive Committee for the assistance they rendered me at all times. I desire to make special mention of our secretary-treasurer, who was ever cheerful and willing to do everything I asked him to do, although I know I exacted much of him at times. The relations between the members of the executive have been very pleasant and harmonious, and I trust the same harmony and good feeling will characterize the proceedings of the convention, and that when you return to your homes you will, each one of you, bear away the most pleasant memories of the 10th convention of the C. E. A., the good city of Kingston and its citizens. I wish you all continued prosperity and success in your various spheres.

Mr. C. H. Mortimer read his report as Secretary-Treasurer, which was as follows:

SECRETARY TREASURER'S REPORT.

The membership of the Association has somewhat increased during the year, notwithstanding the removal of a number of names of members who resigned, and of others who changed their place of residence without notifying the Secretary. It perhaps cannot be expected that the membership should increase in the same ratio as in the past, yet there is still large room for expansion if all who should be interested in the work of the Association would connect themselves with it. For example, there are many electric lighting companies who co-operated in the work of the Legislation Committee, but are not yet represented on the membership of the Association. If possible, means should be found to enroll them and obtain their active co-operation in the various departments of the Association's work.

In several of my previous reports I have referred to the refusal of some members to pay accounts of past due fees, on the ground that they joined the Association for one year only. I am still confronted with this difficulty. Under present circumstances it is difficult to know who can be safely counted as members, or what amount of the outstanding fees can be regarded as collectable. I would suggest that the form of application for membership be changed, so as to provide that persons who may join the Association shall assume liability for payment of fees until their resignations have been tendered and accepted.

The number of members at present on the roll is as follows: Active, 213; Associate, 31; total, 244; a gain of 3 since last report.

Three meetings of the Executive Committee were held during the year, viz., on September 14th, 1899, February 10th and July 26th, 1900.

At the first of these, held at the Russell House, Ottawa, Mr. J. Gordon Henderson, Secretary of the Local Entertainment Committee in connection with the Hamilton convention, reported that the account for expenses incurred by the local committee, after having been audited by Messrs. Black and Leyden, had been paid, the balance above $100 contributed by the Association having been obtained by voluntary subscriptions.

The Secretary Treasurer reported funds on hand to the amount of $271.00. Accounts for printing and engraving, in connection with the last convention, amounting to $96.90, were ordered to be paid. The work of the various special committees was discussed, and the Secretary directed to write the chairman of these committees requesting them to call meetings at an early date to consider and prosecute their work. The Secretary was also instructed to request the members of the Association to suggest topics for papers for this convention.

At the second meeting, held at the Russell House, Ottawa, on February 10th, a number of letters were read from members suggesting topics for papers. The Secretary was directed to acknowledge receipt of a letter from Mr. E. Mascart, inviting the Association to send a representative to the International Electrical Congress of 1900 at Paris. Messrs. Street, Gossler, Higman, Cary and the Secretary were appointed a Committee on Papers for this convention. To this committee were referred the suggestions received from members regarding suitable topics. It was decided that Mr. Wallbank be invited to submit a paper on "Meter Inspection," and Messrs. Keely and Higman to prepare a public demonstration of Wireless Telegraphy. The Secretary was directed to send accounts to members in arrears for fees, giving them notice of draft if the amount should not be paid within ten days. A large local committee was appointed to make all necessary arrangements for the convention, and the sum of $150 was voted for the use of this committee. It was resolved that the annual convention be held at Ottawa on the 27th, 28th, and 29th of June, 1900.

Owing to the disastrous fire which occurred in Ottawa shortly after this executive meeting, it was found necessary to postpone the convention until September, which was done with the unanimous consent of the Executive Committee, and the members notified accordingly. Subsequently a cordial invitation was received from the Mayor and citizens of Kingston to hold the convention in that city, which invitation was accepted by the Executive Committee at a meeting held in Toronto on July 26th last, with the approval of the President and other members resident in Ottawa. The 29th, 30th and 31st of August were selected as the dates for the convention. The President and Mr. A. B. Smith were appointed a committee to assist in making the local arrangements. One hundred dollars was voted to-

wards the expenses of the local committee. The Secretary was directed to notify manufacturers and dealers in electrical supplies that free accommodation would be provided during the convention for exhibits, also labor and current free for installing and operating same. The Secretary was authorized to procure the services of a stenographer to report the proceedings of the convention. Five persons were elected to active membership in the Association, and several resignations accepted. In the case of members in arrears for fees the Secretary was directed to notify them that their resignations could not be accepted until all indebtedness to the Association is liquidated.

Following is a statement of the receipts and disbursements :

FINANCIAL REPORT FROM JUNE 1ST, 1899, TO 31ST MAY, 1900.

RECEIPTS.

| | | |
|---|---|---|
| Cash in bank June 1st, 1899 | $137.76 | |
| Cash on hand June 1st, 1899 | 17.85 | |
| 194 Active Members' fees at $3.00 | 582.00 | |
| 21 Associate Members' fees at $2.00 | 42.00 | |
| 50 copies Convention report | 5.00 | |
| Exchange on Cheque | .25 | |
| | | $799.64 |

DISBURSEMENTS.

| | | |
|---|---|---|
| Expenses of Convention : | | |
| Grant to Local Committee | $100.00 | |
| Geo. Angus, Stenographer | 26.00 | |
| C. R. Lane (Assistant to Secretary) | 3.00 | |
| Electrical News, printing account | 96.90 | |
| Express Order | .25 | |
| Express charges | .60 | |
| | $226.75 | |
| Grant to Secretary | $125 00 | |
| Secretary's travelling expenses to Ottawa attending Executive meetings | 31.00 | |
| Postage | 35.61 | |
| Exchange on cheques and drafts | 13.38 | |
| Express charges | .59 | |
| Telephone messages and telegrams | 2.85 | |
| Stationery and printing | 16.50 | |
| | | $451.68 |
| | | $333.18 |
| Balance in bank May 31st, 1900 | $339.83 | |
| Balance on hand May 31st, 1900 | 11.20 | |
| | | $351.03 |
| Unpaid accounts | | 17.85 |
| | | $333.18 |

RECEIPTS.

| | | |
|---|---|---|
| Money on hand June 1st, 1900 | $11.20 | |
| Money in bank June 1st, 1900 | 339.83 | |
| 25 Active Members' fees at $3.00 | 75.00 | |
| 4 Associate Members' fees at $2 | 8.00 | |
| Envelopes used by Legislation Committee | 1.00 | |
| | | $435.03 |

DISBURSEMENTS.

| | | |
|---|---|---|
| Convention buttons | $6.25 | |
| Telegrams | 1.83 | |
| Postage | 15.00 | |
| Exchange on drafts | .90 | |
| Ribbon for badges | 1.11 | |
| Stationery | .60 | |
| Money on hand, August 27th, 1900 | 17.01 | |
| Money in bank, August 27th, 1900 | 392.33 | |
| | | $435.03 |

The President : As the consideration of reports is put down for to-morrow morning, it may be laid on the table until then. According to custom, I will appoint Mr. A. B. Smith and Mr. B. F. Reesor to audit the Secretary-Treasurer's report. The next item is the reports of standing committees. We had a Committee on Statistics which was appointed two years ago, and continued last year. The Secretary will read you the report.

The Secretary read the report of the Committee on Statistics, as follows :

REPORT OF COMMITTEE ON STATISTICS.

MR. C. H. MORTIMER, Secretary C. E. A.

DEAR SIR,—I have your favor, also one from our respected President in reference to my work as Chairman of the Statistical Committee of the C.E.A., and am very sorry to say that, while I have gathered a lot of interesting information and data, I have not been able to put it properly together or tabulate it in such shape that it will be of much value to the Association. I have been too busy to pay any attention to the matter beyond trying hard to do a little from time to time, and in that manner hoped to have had a fairly good report, but my trip to Winnipeg coming in within the last four weeks, completely destroyed any chance of my getting a report ready. I must ask the indulgence of the Association, and can only plead that the days are not long enough and not many enough to get through my business engagements, let alone any additional work. I must therefore ask that you kindly relieve me of the Chairmanship of this Committee and appoint somebody who will be able to give it more time and attention. I have considerable data which I would be glad to hand over to whomever you may designate. I trust you will have a very successful meeting and hope to be able to be with you one day at least.

Yours very truly,
(Signed) J. A. KAMMERER,
Chairman Statistical Committee.

The Secretary read the report of the Committee on Meter Inspection, as follows :

REPORT OF COMMITTEE ON METER INSPECTION.

To the Canadian Electrical Association :

GENTLEMEN,—Your Committee on Meter Inspection beg to report that they have since the last meeting of this Association interviewed the officers of the Electrical Inspection Branch of the Inland Revenue Department, with a view of ascertaining if the working of the Inspection Act could not be made easier to the electric light companies, and less expensive.

We have very much pleasure in reporting that we obtained a concession in the matter of inspection fees, viz: That whenever a meter requires inspection before the expiration of the five years covered by the last regular inspection, it shall be certified by the department for a fee of 50 cents only instead of the regular fee.

This, while it affects a saving to the companies, is also an evidence of the desire of the department to meet the electrical companies half way, and make the operation of the Act as little irksome as possible. I am,

Yours very truly,
A. A. DION, Chairman.

Mr. J. J. Wright read the report of the Committee on Legislation, which was as follows :

REPORT OF COMMITTEE ON LEGISLATION.

It was considered last year, at the time when the Conmee Act became law, that while there was not much danger of the fundamental principle of the bill being abrogated, that amendments would be brought forward from time to time which would, while intended to apply to special cases, interfere with the general working of the Act. These expectations were more than realized, for not only were amendents proposed in several ways, but a separate bill was introduced by Mr. Graham purporting to amend the Conmee Act in one or two particulars, but in reality repealing the Act and re-enacting an ingeniously worded measure that would have utterly destroyed the usefulness of the Act as originally passed by the Legislature of 1899.

It became necessary then for your Committee to take active measures to meet this threatened attack. In the meantime, in the expectation that some work would have to be done and expense incurred, a request was made to the various electric lighting companies interested for financial assistance, and a draft made upon the basis of the former subscriptions paid in. A sum amounting to about $400 was realized by this means, which was thought would be sufficient for the purpose, but the sweeping nature of the so-called amendments and the postponement of action, from time to time, by the parliamentary committee having the matter in hand, necessitated a much larger outlay. As the work of council retained by your Committee, as well as the efforts of individual members, held forth promise of ultimate success, it was deemed inadvisable for the sake of saving additional expenditure to jeopardise the success of work already accomplished. It was thought that the benefits accruing to the companies interested would be ample justification for this, and that in view of the important work accomplished we could reasonably look forward to increased assistance to enable all liabilities to be fully met.

The total disbursements on this account have been :

| | |
|---|---|
| For legal services | $765.00 |
| For telegrams, postage, stationary, printing, exchange, etc. | 62.78 |
| Making a total of | $827.78 |

To meet this there has been subscribed, during the year, the amount of $719.25, which, with $75.67 on hand from last year, makes a total of $794.92. This deducted from the total expenses leaves a deficit yet to be made up of $32.86.

While as a result of this effort the principles of the Conmee Act has become more firmly established than ever, it is altogether likely that further efforts will be made to amend or nullify it at future sessions of the legislature. Although this opposition will become less and less serious as time progresses, it will be necessary for this Association, as representing the industry of electric lighting and the distribution of power, to prepare to repel and neutralize these repeated attacks.

Your Committee has thought that some action should be taken to consolidate in a greater degree the interests involved, that special effort should be made to have every electric lighting company in the province identified with the Association. A number of companies who have benefitted to a marked degree by the work done by this Committee have not contributed in any way to the expenses incurred. If every company who are interested would assume a fair share of the burden, it would merely be a nominal one, and provision in a proper manner would be made to meet these periodical attacks upon their interests. Your Committee would recommend that the Association take some action looking to the consolidation of these interests and to a proper method of again making provision to meet attacks upon this legislation.

The number of companies and individuals who have subscribed towards the fund this year is 76; last year the number was 51. The names of the contributors are as follows :

Mattawa Electric Co.; Jos. Knox, Stayner : Paris Electric Co.;

Trenton Electric Co.; Parry Sound Electric Co.; North Bay Electric Co.; Tilsonburg Electric Co.; Rat Portage Electric Co.: Woodstock Electric Co.; Robertson, Rowland & Co., Walkerton; H. Gruetzner, Hanover; Aylmer Electric Co.; Wingham Electric Co.; Bowmanville Electric Co.; W. Moore & Sons, Meaford; Shelburne Electric Co.; Toronto Electric Light Co.; John Philip, Grand Valley; Madill Bros., Lakefield; Owen Sound Electric & Illuminating Co.; Napanee Electric Co.; Seaforth Electric Co.; Peterboro Electric Co.; Kingsville Electric Co.; Lindsay Light, Heat & Power Co.; Arnprior Electric Co.; Galt Gas Co.; Stratford Electric Co.; Stormont Electric Co., Cornwall; Watford Electric Co.; Leamington Electric Co.; Pembroke Electric Co.; St. Catharines Electric Co.; William Snider, Waterloo; People's Electric Co., Windsor; St. Thomas Electric Co.; Gananoque Electric Co.; Welland Electric Co.; Port Hope Electric Co.; Sarnia Electric Co.; Smith's Falls Electric Co.; Uxbridge Electric Co.; Ottawa Electric Co.; L. H. Reesor, St. Marys; Strathroy Electric Co.; W. A. Mackay, Renfrew; A. A. Wright, Renfrew; Cataract Power Co., Hamilton; Howes & Leighton, Harriston, Ont.; Simcoe Gas & Water Co.; Cobourg Electric Co.; Norwood Electric Co.; Carleton Place Electric Co.; Brantford Electric & Operating Co.; Alliston Electric Co.; London Electric Co.; Kingston Electric Co.; Gravenhurst Electric Co.; Hamilton & Prout, Forest; Dunnville Electric Co.; Guelph Electric Co.; Midland Electric Co.; Berlin Gas Co.; Markdale Electric Co.; Almonte Electric Co.; Georgetown Electric Co.; Ingersoll Electric Co.; Dundas Electric Co.; D. A. McIntyre, Paisley; R. P. Bearman, Chesley; Clinton Electric Co.; Kilmer, Crawford & McIntyre, Durham; Petrolea Electric Co.; I. J. Gould, Uxbridge; Wallaceburg Electric Co.; Wiarton Electric Co.

Your committee is glad to be able to state that the legislation obtained and protected through its efforts has been of the most vital importance to several companies during the year, in preventing what might be termed the absolute confiscation or destruction of their property. At the same time, the measure is eminently fair to the municipalities and protects their interests equally with those of the companies concerned.

Your committee have to express their acknowledgement to those gentlemen who actively assisted them, at considerable sacrifice of time and at their own expense, in defending the rights of the companies before the Legislature.

J. J. Wright,
Chairman Committee on Legislation.

The President: There was a Committee appointed to confer with the Underwriters, a continuation of the Committee of the preceding year; Mr. Gossler is the chairman of that Committee.

Mr. P. G. Gossler: Your Committee appointed at the last convention, consisting of Mr. Sangster, Mr. Dion, Alderman Sadler and myself, met on the 15th January last in the Windsor Hotel, Montreal, with a view of discussing and considering a by-law which it is proposed to incorporate in the building by-laws of Montreal, known as the Montreal Building By-law of 1899. Section 168 of this by-law proposed that all electric installations within the city of Montreal should be inspected and a certificate of inspection, to the effect that the installation is in accordance with the Board of Fire Underwriters' rules, should be issued before such connection was made. Alderman Sadler had taken up this proposed by-law in detail, and after due consideration of the matter, especially in view of there being nothing definite stated in the proposed by-law as to who should stand the expense of this inspection department, it was not thought advisable for your committee to take the matter up in a formal manner. However, as the Secretary of the Board of Fire Underwriters, Mr. Hadrill, expressed last year that he was in hopes that municipalities would pass such by-laws throughout the Dominion that would make the enforcement of the Fire Underwriters' rules part of the building laws, and that the expense of such enforcement or compliance with the law would be stood by the municipalities; it would seem that this by-law was intended to be the first step in that direction, and, after considering the matter at the Windsor Hotel, as I stated before, it was not thought advisable to take the matter up until such time as this by-law was presented for enactment before the city of Montreal. The Committee really has taken no definite steps except to familiarize itself with the proposed legislation, and having Alderman Sadler keep his eye on the by-law as it progresses. There has really been no progress made towards having a definite bureau of inspection established in the Province of Quebec or throughout the Dominion, and at the suggestion of the meeting it was resolved to let the established systems of inspection as then existing remain without being interfered with. I further wish to say that the minutes of that meeting to discuss that by-law in detail, and also a copy of the proposed by-law, will be incorporated in my report to the Association.

The President: There was a committee appointed last year at Hamilton to deal with the proposed "Standardization of Accounts," as suggested in a paper read before that convention. We have a report from Mr. D. R. Street.

The Secretary read the report, as follows:

REPORT OF COMMITTEE ON STANDARDIZATION OF ACCOUNTS.

To the President of the Canadian Electrical Association:

Sir,—As there is apparently an idea on the part of the executive of the Association that I am chairman of the committee "to formulate a standard system of accounting for our central stations in Canada," I take the liberty of reporting that at a meeting of this committee held in the Royal Hotel, Hamilton, on the 30th of June, 1899, at which Mr. Hair, Mr. Wright and myself were present, Mr. Hart was unanimously chosen as chairman of the committee, this being out of deference to him as the author of a very excellent paper on accounting read at the last convention, from which the present committee is the issue.

As Mr. Hart, the chairman, I understand, is in the Lower Provinces, and may possibly not be at this convention, and as it is impossible for me to be there on the first day, I take the liberty of stating that the committee has done some work, though not much. However, a start has been made and a certain amount of correspondence has been done and data collected, forms have been received from Mr. T. E. Oakley, of Fort William; we have Mr. Hart's paper read at last convention, also a communication from the Librarian of McGill College saying that a copy of the report of the National Electric Light Association proceedings held in Montreal some eight years ago, and which contains an excellent paper on accounting, is at the disposal of the committee at the College, but unfortunately cannot be removed. We also had a very good paper upon the same lines that this committee is working, from Mr. Colquhon, submitted at the last meeting of the National Electric Light Association.

Please bear in mind that should Mr. Hart be present, as he possibly may, he will, of course, have his own report as chairman, and I would respectfully request that this letter to yourself should in that case not be used.

Yours truly,
D. R. Street.

The President: There was a proposal to establish a standard for arc lamps which could be embodied in contracts to take the place of the old standard of 2,000 or 1,200 c.p., which led to many disputes; it was taken up at the last meeting and discussed to some extent and a Committee appointed to make some suggestion at the next convention. Mr. Higman, of Ottawa, was chairman, and Mr. Gossler was a member of that Committee. As Mr. Higman is not here and has sent no report, perhaps Mr. Gossler could make a verbal report of what has been done by that Committee during the year.

Mr. P. G. Gossler: Mr. President, after consideration of the matter and the remarks that were made at the last convention, it was thought that it would be premature to decide on any definite standard at the present time for illumination of arc lamps. There are so many possibilities of inaccuracies being introduced in the rating of street lights on a basis of c.p. that such a rating has almost been entirely superseded by the watt basis, that is, the watts consumed per lamp, and at the present time the same energy in different types of lamp gives a very decided difference of illumination; it was thought best to not even make any suggestions towards a definite standard until such time as there was more universal accord on the subject of exactly what energy should be used in lamps, or what illumination could be expected from different classes of lamps. As you all know, there is a very great diversity of opinion on the subject.

Mr. J. Yule: Wasn't there a resolution carried?

Mr. Gossler: Not being chairman of the Committee, I am really not familiar with the details. There may have been a resolution. You were present, were you not, Mr. Yule?

Mr. Yule: Yes.

Mr. Gossler: You were a member of that Committee.

Mr. Yule: My recollection is there was a resolution.

The President: My recollection is we passed a resolution in order to narrow down the discussion, which had been of a very rambling character. A resolution was passed to bring the discussion within a certain channel, but that resolution was to the effect that the rating should be on a wattage basis, and there were

some other things besides that which were to serve as a basis for discussion at a future meeting, but that other meeting not having been held, I don't know that it would be wise to present the conclusions of that first meeting as a report. It was only preliminary, and it may have been all undone at a subsequent meeting. I agree with Mr. Gossler that it would not be safe to express ourselves on this point which is now engaging the attention of more important bodies elsewhere; we might let them speak first. Possibly to-morrow, when the consideration of these reports comes up, we might decide to continue the committee and see what they can do next year.

Mr. Gossler: In connection with Mr. Yule's suggestion of a resolution having been passed relating to the wattage to be used per lamp, I may say that there may be the same wattage in the arc and yet have altogether a different illumination. Of course, it depends upon the character and size of the arc.

Mr. Yule: You were asked to report on that.

Mr. Gossler: If I was I certainly have overlooked it. I have not gone into it with a view of making a report. I could possibly talk for an hour and a half on the subject of arc lamps, but I didn't know I was to make a report.

Mr. Yule: I mean to a subsequent meeting of the Committee, not to this convention. It is understood this Committee has no power whatever; they simply make a recommendation to the government department.

The President: The next order is the appointing of the Nominating Committee. The duties of this Committee are to suggest names for the various standing committees for the coming year and for the officers to be elected on the 31st. I will appoint on this committee Messrs. E.E. Cary, P.G. Gossler, J.J. Wright, J. Yule and J.F.H. Wyse. If these gentlemen will get together between this and to-morrow, they can take as a basis for the committees last year's list; the same committees will very likely be continued, and suggest who should compose them, as well as the officers for next year. This is intended as a guide and a help to the convention. It is not binding by any means, and other nominations can be made when the time comes.

The President: I think if there is any general business to be brought before the convention, we should hear it now, because the author of the first paper on the list is not here yet, and the time at our disposal this morning is short.

Mr. J. J. Wright: On the other hand, there are others who have some business to bring before the convention, thinking it will come after the reading of the papers.

The President: I would like to have a little larger audience for the reading of the papers, and I think we will have it this afternoon.

Mr. J.J. Wright: I would suggest that an adjournment would be in order now until the afternoon session.

The President: I am sorry to see such an old member as Mr. Wright talk about wasting time in this way. However, if that is your wish, all right.

Mr. Wright: If there is any business to come before the convention which members wish to bring up now, I am quite agreeable.

Mr. J.F.H. Wyse: I understand there is a motion to adjourn. I second the motion.

Mr. Gossler: As a further suggestion, I know that on the next train from Montreal there will be at least ten or fifteen members, and it will be hardly fair to them to proceed. However, it may not be fair to us for them to stay behind. But a postponement for an hour or two hours will probably not be out of the way.

The President: It is moved by Mr. J. J. Wright, seconded by Mr. J. F. H. Wyse, that this meeting adjourn until 2.15 this afternoon.

On a vote having been taken, the motion was declared carried.

AFTERNOON SESSION.

At 2.45 p.m. the President called the convention to order.

The President: The first order is general business; if there is nothing in the way of general business, we will pass on to the reading of papers. The first paper is by Mr. Camp, C.P.R. Telegraph Company, Montreal. I have a telegram from Mr. Camp stating that he will arrive at 4.30 this afternoon, and asking us to postpone the reading of his paper. The next is a paper by Prof. Owens. I have a letter here stating that Prof. Owens has been called away to Maryland on account of the death of his sister. Prof. Owens did not send in his paper. The next is a paper by Mr. F. H. Leonard, of Montreal. Mr. Leonard is in the city, but is not here just now, and as it is getting late, Prof. Herdt has consented to read his paper now. The paper is on "Conditions Affecting the Wave Form of Alternators."

Prof. L.A. Herdt, McGill University, Montreal, read his paper. (See page 171).

The President: You have heard the able paper by Prof. Herdt. As he has stated, the subject is of great importance, especially now when alternating current generators are being used to such an extent that all services, not only incandescent lighting, but arc lighting and motors, are furnished from alternating current generators. To those of us who have been accustomed to look upon the sine curve as approximately correct in dealing with alternating current phenomena, the results shown here are somewhat startling. This paper is open for discussion, gentlemen. I regret the fact that the papers could not have been placed in the hands of the members some time before the opening of the convention, because papers of that nature require some study. It was our purpose that there should be opportunity for studying them. I must say, however, that although the Committee on Papers have used their utmost endeavors to get the papers printed in time, they have failed. Could we hear from Mr. Leonard on this subject?

Mr. Leonard: Well, no, I am hardly prepared to say anything on Prof. Herdt's paper. I didn't come into the room until the paper was half through, and I would like to study it a little further before taking up any discussion on it.

The President: Perhaps we had better postpone the discussion on this paper until to-morrow. Are there any gentlemen here who would like to discuss this paper?

Mr. Gossler: I would like to ask Prof. Herdt a question for the purpose of getting information. Not having read the paper, I am not very familiar with its contents. Plate 3 shows different curves of electro-motive force and different power factors there, and I notice that the maximum electro-motive force of each curve comes within possible 15 degrees of either side of the 90 degree line. You have shown here electrical degrees from zero to 180, and the maximum electro-motive force on all those curves is within 15 degrees either way of 90 degrees. You have your maximum electro-motive force practically on a straight line.

Prof. Herdt: Yes.

Mr. Gossler: I was under the impression that frequently the demagnetizing effect distorted the magnetic field so as to throw the maximum E.M.F. further than 15 degrees one way or the other.

Prof. Herdt:—The ordinates of the curves at load have been plotted 60 volts below that of the preceding ones, for clearness. At full load, 100 per cent. power factor, the electro-motive force is shown to be shifted about ten degrees in the direction of rotation; however, as the power factor is decreased, this is gradually reduced until we find that with a power factor of 55 per cent., the electro-motive force wave is nearly back in the original position of the no load wave.

Mr. Gossler:—It is an individual characteristic of the machine. I should say that was a very good machine.

Prof. Herdt:—It is a very good machine. If you like to consider that later, Mr. Gossler, we can do so.

Mr. Gossler:—I just wanted to get that information.

The President:—Is there any further discussion? If not, we will go on with Mr. Leonard's paper, and we will give you an opportunity to take Prof. Herdt's paper

up again to-morrow. I have much pleasure in calling upon Mr. F. H. Leonard, of Montreal, to read his paper entitled "Power Factor as Affecting Operation and Investment, with Special Reference to Induction Motors and Enclosed Arc Lamps."

Mr. F. H. Leonard read his paper. (See page 173).

The President: Gentlemen, I think I may state that this is one of the best papers we have had submitted to this Association. It deals with matters that as central station managers some of us have to consider very seriously, and I wish you would give it a very full discussion. It contains a great deal of interesting matter, from the standpoint of theory as well as that of practice, and I hope it will receive due consideration. It is now open for discussion.

Mr. E. E. Cary: Mr. President, don't you think it is somewhat necessary to allow the members to digest these papers over night. There are a number of modest individuals here, and their digestion is a little out of order, and it is only in the morning they are prepared to tear the papers to pieces. I would offer the suggestion that we read another paper and then discuss the three of them in the morning.

The President: I am quite agreeable to that, but if there are any members here who have anything to say on the papers now, or wish to ask for ioformation, I think we might hear them.

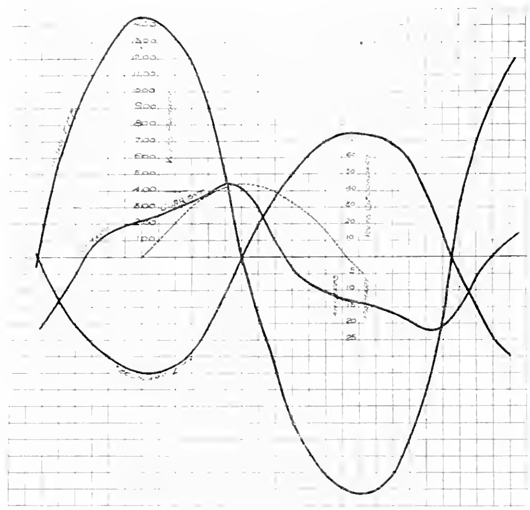
Prof. Herdt: I would like to say a word in regard to one paragraph here at the top of page 5: "If this leading phase displacement can be made equal to the lagging phase displacement of other devices, a power factor of unity would result, as suggested by an eminent engineer, though in practice, during a period covering the whole history of this branch of the art, I have never met such a condition, nor have any of my friends in the profession, many of whom have had extensive experience with synchronous and induction motors separately and both together on the same circuit." In regard to that point, is it not so that the difficulty in obtaining unity power factor is due to the difference existing between the wave form of the generating and receiving machinery? Still in most cases it seems that with a proper adjustment of field excitation the power factor may be made to reach very close to unity.

Mr. Leonard: On that subject I can state at the end of an experience extending over several years in manufacture and experiments leading up to the manufacture of a single phase, self starting synchronous motor, I have concluded, as I intimated in the paper, that over-excitation cannot be carried too far. If a synchronous motor is over-excited beyond a certain limit, it begins to make the circuit unstable and there immediately results a very vigorous pumping and flickering of the lights which makes the thing utterly impracticable on a commercial circuit. Theoretically it may be otherwise, but in practice there are mechanical and electrical difficulties which enter into the question that, so far as I have been able to learn, put the thing out of the question entirely. I would like very much to meet somebody that has ever had the experience of obtaining the power factor of unity on motor work. I have talked on the subject frequently with many of my friends who are quite prominent in the profession, and who have had excellent opportunities to investigate this matter, but up to now I fail to find anybody who has secured this wonderful, or what seems to me wonderful, result. It is theoretically all right and should be obtained, but in practice it seems to be out of the question.

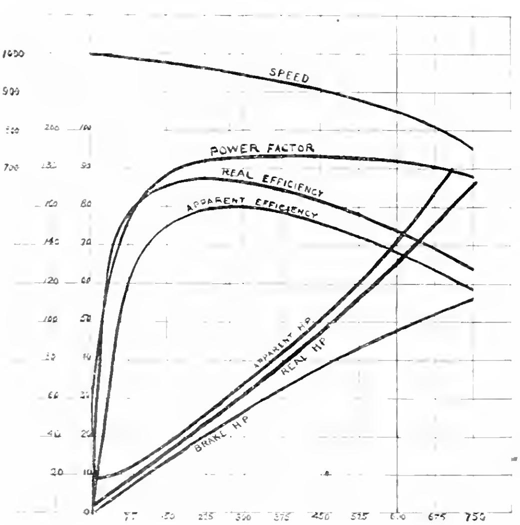
Mr. Gossler: In regard to the matter of unity power factor, does not Mr. Leonard mean to say that the power factor of unity is rather an unstable quantity under commercial conditions, and not that it cannot be procured, for I know unity power factor can be obtained, but there has been difficulty experienced in maintaining unity power factor under commercial conditions. It is a well known theoretical fact that unity power factor can be obtained, but there has been experienced considerable difficulty in maintaining unity power factor on account of the unstable conditions existing at the time. I have not had an opportunity of reading this paper before it was presented, and as it is going to be discussed to-morrow, I desire to bring up a few points for information, and which I should like to hear discussed in the morning. I notice that after a discussion of the characteristics of the synchronous and induction motors, that the statement is made that the preference is altogether in favor of a well designed induction motor. Now, while the usefulness of the induction motor is without question, there are also certain conditions which make the synchronous motor almost indispensable to a large operating system. When under the control of the central station the synchronous motor is one of the most valuable adjuncts to a general supply system. This is well illustrated under practical conditions in the Buffalo arc light system, where the power factor on the general system is maintained, I understand, under their conditions at about .97 or .98. I do not think there is any claim that induction motors operate at a power factor of .97 or .98, or that they can be made to better the power factor system so as to maintain it under normal conditions anywhere in the neighborhood of .97 or .98. It therefore seems that the impression which I have obtained from Mr. Leonard's paper that the preference is to be altogether in favor of a well designed induction motor over the synchronous motor, is wrong. I know of several large installations that are at present being designed where it is proposed to install synchronous motors. In another part of Mr. Leonard's paper he has compared the action of the induction motor to a transformer, stating that, being complete in itself, the regulation was automatic. The impression which I have gained from this statement is that there is no regulation of the generator required to overcome increases or decreases of the load on induction motors. The operation of induction motors shows that regulation of the generators is necessary to compensate for changes in load on the motors. We know that throwing a load on an empty transformer increases the power factor of the general system, and consequently permits of better regulation, for the reason that it brings the current more nearly in phase with the electro-motive force, but certainly regulation of the generator is required to compensate for any increase of load on the transformer, even if the load introduced does bring the current more nearly in phase with the electro-motive force; consequently the impression given in this paper that an induction motor causes an automatic regulation of the system, and no change of field excitation is required, is incorrect. Mr. Leonard further states that the best load for a synchronous motor is one of a steady character. This same statement applies to induction motors, engines, water wheels, or any motor. Mr. Leonard has stated that as high a power factor of an induction motor under full load conditions has been obtained as .94, but there are very few conditions, especially when there are a great many of them, which allow of motors being operated continuously at full load. There has been reference made to an operating plant where in one installation there are about 3,000 h. p. in motors, ranging from fan motors to motors of 500 h.p., and that recent measurements showed the power factor of the circuits supplying this installation to be about .90. I think I know what plant Mr. Leonard has reference to, because I operate it. I may say we found that under certain conditions we had on our transmission lines supplying our entire system at our power house a power factor on a commercial load of about .94; the load consisting of a general lighting and power business; several large motors being of the synchronous type; we found that by removing about 25 per cent. of the synchronous motor capacity, and placing additional induction motors on the system, the power factor was reduced from .94 to .87, thereby reducing the full load unity power factor capacity of the generator from about 88 to 75 per cent. In stating that it is necessary to have synchronous motors started by means of external starting apparatus I presume the self-starting synchronous motors have been overlooked. However, the latter absorb a large amount of starting current, frequently several times the full load current. I also know of a number of induction motors in commercial use that require several times the full load current for starting. I think the Association is certainly very much indebted

to Mr. Leonard for that paper, because it is on a subject that is pretty close to us all. I think we all regret that we have not had a chance to make a pretty close study of it before it was presented. There is one more note I have marked in reading it over. Mr. Leonard, I see further on, recognizes there is some use for synchronous motors. He says: "In some notable cases where central stations are using power transmitted from a distance, induction or synchronous motors have been coupled direct to D.C. arc dynamos; this would be the ideal place to use a synchronous motor immediately under control of the central station if the induction motor load occurred at the same time, but unfortunately they occur at different periods." The maximum demand on a central station supplying light and power is at the time when the lighting of offices and stores and the day power business overlaps the evening lighting load. In Montreal this overlapping of day load and evening load occurs during seven months out of the year, also, at the same time the arc lights are operating, so that the power required to operate them is in demand at the time of this overlapping; consequently any synchronous motors used to operate arc machines could, during seven months of the year, be used to better the power factor on the general system, in consequence of which there would be available more generator capacity than if the arc lights were operated by means of motors having a lower power factor than that obtainable with synchronous motors.

Mr. Leonard: I don't think I differ so very much from Mr. Gossler on a good many of the points. I called attention particularly in my paper to the fact that there are places in which a synchronous motor can be used to great advantage in overcoming line drop. If you could distribute synchronous motors at certain centres of distribution where your drop is heaviest and your variation in load the greatest, and you have an attendant there in charge who is under control of the central station, as I say in the paper, it would certainly serve as a very valuable adjunct to the central station management. You would reduce the amount of copper and you would require less attention at your switchboard, although that would have to be made up by the attention of the man at the motor, while under those conditions it would be necesssary to have the synchronous motor large enough in capacity so as to take care of the work it has to do as a motor, and besides that have capacity for furnishing leading currents to overcome the lagging currents produced by other inductive devices. With regard to power factor, Mr. Gossler in his remarks made a little slip; he said that the induction motors made the power factor higher. I think he meant the reverse. The case that Mr. Gossler mentions was one where we took the two synchronous motors (we only had two on) off our line, and in place we put in all of the small induction motors, many of which were running under load. A small induction motor does not give as good a power factor usually as a large one; they improve slightly as the size increases, but a small induction motor with a light load, it is recognized, has a lower power factor; and as I say in my paper, the regulation of the line may be improved by the use of the induction motor. I think that experience will bear that out. We have at full load a very high power factor. I have a diagram here which I have taken and I will put it up. This is the line we have been considering; that is the power factor. This, I may, say is taken in actual practice from a modarate sized induction motor; it has a capacity of 50 h.p. This is the full load line here. Now, you see the power factor starts at about 20. The observations are not very accurate on these starting loads; here we start with a power factor of about 20—at practically no load. It almost instantly reaches 40, and then up to 60, and then rises gradually as the load increases, this line crossing under here and going over this point up to 93, almost 94, with even that small-sized motor, where the generator conditions and so forth are right. What I was trying to maintain was that the regulation of the line is assisted—not altogether compensated for, I might say—but assisted by the use of induction motors rather than synchronous motors. At full load we have a power factor of .93, and we will say at 25 per cent. overload we have got very nearly .94; all over this range the power factor is very nearly uniform. I call attention in the paper to the fact that the induction motor should be selected particularly with regard to the amount of work it has to do, so as to obtain the best conditions of power factor. That is, if you have a load of 10 h.p. for five minutes out of the day, and 7 h.p. for the other nine hours and 55 minutes, you should buy, not a 10 h.p. motor to take care of that 5 minutes, but a 7 or $7\frac{1}{2}$ h.p. motor so as to obtain the best conditions. You can stand an overload of 25 per cent.; your power factor is really improved by that load; all over this range your motor is running at good power factor; if there is any slight increase or overload the motor is safe if it is properly designed, as it should be designed under those conditions. If you throw a load off from an induction motor you immediately reduce the power factor. Mr. Gossler said the power factor will vary the electro-motive force something like the square of the variation in the power factor. Under those conditions you have thrown off your load, your generator has lost part of its load; the natural tendency of any generator with fixed excitation would be to increase its

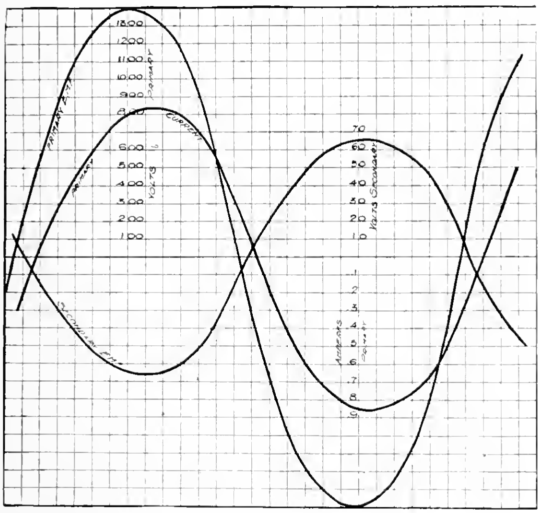


Transformer Curves—Open Secondary.




Performance Curves—50 h. p. Induction Motor.

electro-motive force; it would immediately, if you throw off a certain amount of load, build up and increase the electro-motive force. With an induction motor having its load thrown off, it brings the power factor down into this part of the curve (refers to diagram), and in doing so it demagnetizes the field of your current generator and prevents the increase of the field and lowers the electro-motive force slightly and compensates, in a measure, for the change of load. I don't mean to maintain that that will compensate automatically for every change. You cannot do away with your switch-board attendant entirely, but I merely wish to call attention to the fact that it assists



Transformer Curves—Full Load.

in the regulation; whereas in a synchronous motor, if a load is thrown suddenly off, your voltage immediately rises. You have introduced leading currents, you increase your field strength by the armature reaction, it raises the electro-motive force immediately and will cause trouble with incandescent lights if your attendant is not very sharp with his work. If there are are any other points I would be very glad to take them up to-morrow morning. I will give a chance for somebody else to say a word now.

The President: Are there any other members who wish to speak on this? There is a point mentioned by Mr. Leonard at the top of page 5 where he states that a leading current may be produced in a synchronous motor to compensate for the lagging current due to other devices. He says, it has been stated by an eminent engineer, and it has been stated by a number of authorities, and it is a question which central station managers who are operating alternating current motors want to know all about. I may say it has been stated to me by eminent engineers of manufacturing companies, that while this was theoretically so, it was, as stated by Mr. Leonard, almost impossible to realize in practice. Now, this is the point we want to know about. It has been held by people who are interested in having synchronous motors used that this is a valuable feature of the synchronous motor, that you can use it to off-set the lagging currents due to other motors or other devices on your circuits. Others state that it is impossible to obtain these results in practice, except under conditions which have to be so nice that you do not get them as a general rule, and if anybody can give us more light on this particular point to-morrow we will be very glad to have it. If there is no further discussion to-day we will allow the paper to lie on the table for further discussion to-morrow, and we will pass on to the paper on "Some Experiments with Rotary Convertors," by Messrs. A. G. Grier and J. C. Hyde.

Mr. Grier read the paper. (See page 175).

The President: The auditors whom I appointed this morning have completed their work of auditing the accounts of the Secretary-Treasurer and have certified them to be correct in every particular. If there is any general business to bring before the meeting this would be a good opportunity, a better chance now than to-morrow. If there is nothing I would ask someone to move an adjournment.

Mr. J. J. Wright moved, seconded by Mr. P. G. Gossler, that this meeting adjourn until to-morrow morning at 10 o'clock. Carried.

## SECOND DAY.

At 10.30 a.m. the President called the convention to order and said: The first item is the consideration of the President's address. The reason for this order of the day is that there are some suggestions in the President's address which may be taken up by the Association. As you know, there are still a number of electric companies in Canada that are not represented in this Association, and it has always been the aim of the Executive Committee to bring these in, if possible. I will read you the suggestion which is made in the address in connection with that: "It is a source of gratification to me that our membership continues to increase notwithstanding that a considerable number of members drop out of the Association every year. We should put forth our best efforts to prevent, if possible, these annual lapses, and we should not rest satisfied until every electrical operating, manufacturing and supply company, firm or individual is represented on the membership roll. In this connection I would submit for your earnest consideration whether it would not be well to introduce in our constitution a feature of company membership such as carried out by the National Electric Light Association of the U.S. in addiion to the individual memberships, which could remain open to those who wished to avail themselves of them." I thought it would be well to get an expression of opinion from the convention as to that feature. Can we hear from Mr. J. J. Wright on that subject? It is a matter we may not be able to dispose of now, but it would be well to talk it over. You know that the National Electric Light Association is composed of companies; the companies pay $25 a year and send their representatives. It was thought that where the companies do not send the same members every year, that company membership would be, perhaps, a means of getting the companies interested.

Mr. J. J. Wright:—As I understand it, there are a number of companies represented in our association already.

The President: As companies?

Mr. Wright: As companies, I think.

The President: No. Their officers are members individually. We have no such thing as company membership.

Mr. Wright:—That would be an amendment of the constitution, and would require notice for one session. I am willing to introduce a resolution to that effect, giving notice of an amendment of that kind, and leave it to be discussed at the next convention. We cannot take any action on that except to propose it.

The President: I thought if we could get an expression of opinion from the convention, the executive committee for the coming year would know what to do.

Mr. Wright: That would blend itself with another matter which will probably come up later, and that is with regard to identifying the electric companies with the Association in the matter of looking after legislation and so forth. If the electric light companies are to become interested in the Association as companies, of course the Association would be in a very much stronger position to take hold of matters connected with legislation; and the present haphazard method of making provision for legislation by raising subscriptions and so forth would be very much simplified. We have no means now except by making a draft on the various companies as occasions arise; we have done that al-

ready three times practically, and it is a question, of course, how far it is proper for that method to continue, and that is a matter which I think will have to be taken up by the legislative committee and executive committee, probably jointly, during the coming year, to see whether an organization of that kind could not be completed. Your suggestion, perhaps, that the companies should become interested, might be right in line with that idea.

Mr. H. R. Leyden : It seems to me that is exactly the line in which this association has been developing for the last couple of years. This association is not what you would call an association of electrical engineers ; its principal object and its principal work has been the benefit of the companies. The men who come here to this association are usually sent here by the companies and their expenses paid by the companies. As Mr. Wright says, one of the principal objects of the thing is for the enacting of such legislation as will protect the companies, and it is the companies that have been paying for the expense of such legislation, and it seems to me we have been gradually working away from the idea of an electrical engineers' society and becoming an association for the benefit of electrical interests ; and it seems from that point of view it should be the companies who are represented and not the individuals.

The President : There is this difference between our society and the American association, that while a company sends a representative here and pays his expenses, if that company wishes to send another representative next year he has to get a membership, while if the company held the membership and paid a higher fee than the individual subscription, that company would be free to send any representative or any number of representatives. Of course, when it comes to voting, the voting will have to be limited, but any number of representatives might be present at the convention from one company.

Mr. Gossler : I don't like to see the idea encouraged suggested by Mr. Leyden that we are working away from an engineering body ; the matter of legislation and commercial operation of our plants can be managed by purely business men and business associations ; I would very much rather encourage this as being more of an engineering society for the advancement of engineering and commercial operation. I think your suggestion of having the company membership is a very excellent one, as it will bring the association to address the companies rather than their individual representatives ; that is, the association has had its support from the companies, and it has gotten that support from individual efforts rather than making a direct appeal to the companies. I think the suggestion as put forth by the President should be put in formal shape, perhaps by resolution put before the association, which will allow it to become a part of the constitution of the association.

Mr. E. E. Cary : I think Mr. Gossler's suggestion is a very good idea, but one point that appeals to me is this, I think both the commercial interests and the scientific interests can work harmoniously. Our meetings in the hall, the same as in our neighboring Association on the other side, would generally be devoted to the scientific side of our work ; naturally, the other side gives more or less entertainment when we are not iu the hall for discussion. The papers will be more scientific than commercial, of necessity. In addition to this I would like to say a few words regarding the matter of exhibits. This is the first year that any of us have been privileged to exhibit under the auspices of the Association. There is a peculiar meaning in that to me. The manufacturer or jobber gets the agency from any foreign country of any special apparatus which have been developed and brought out during the year, it may have been described in the journals, but very few of the central station managers, perhaps, have been privileged to see the latest developments—the large exhibits such as the Electric Light Association have on the other side bring together all the latest developments of the year ; it is not to sell, at the time ; in fact, the manufacturer or jobber who respects himself would severely reprimand any representative who tried to really do business, but it is to our interests to have the criticism of central station managers upon anything we bring out, because no matter how carefully we may test any apparatus, I never saw a piece of apparatus placed on the market that central station managers could not tear to pieces and improve. They have conditions which we cannot always duplicate in our testing rooms, notwithstanding our best efforts to do so ; consequently, we get their suggestions, and they see the results of our efforts. You may say, that is purely for commercial reasons. We are all after the money, there is no doubt about that, but unless you have the best and most economical apparatus you cannot make as much money during the year following the convention as if you had it. And I think any manufacturer, if he appreciated that element the way it is appreciated in the old country and in the United States, would make an effort to show auything of recent development, and the means he has devised to help you in your operating expenses. I think both sides, the strictly scientific and the commercial elements, will not conflict, but will harmonize, because our papers will be scientific, and between our sessions we can view the exhibits, and the more working exhibits we have I think the better everyone will be pleased. I feel very strongly on this matter, for I was interested for some twelve years on the other side, but as you all know we have not been privileged to do anything here before. The time has been extremely short this year. We are not as busy as our competitors, so we had more time to devote to it. But another year, it it is thoroughly understood, you will find all the manufacturers here exhibiting. I had to work nights, gentlemen ; I worked overtime. We have not much upstairs, but we manufacture bunting and ice cream and so forth at St. Catharines, and that is what we are showing. Another year we will show you some apparatus. (Applause).

Mr. Yule : Of course, I represent purely the commercial side of the electric light business. As it is, there is a good deal in what Mr. Wright says, that company membership would interfere somewhat with another proposition we have to bring forward. There is one thing about company membership in getting a fee sufficient to meet our expenses, and that is, you cannot get the same amount of fees from a small company that you can from a larger company. Some of them are not able to pay a very large fee, and some of them are able and willing to pay it. The conditions on the other side are very much different from what they are here, and we have to modify our plans. This question will come up again, I understand, in the legislation report. I would move that the recommendation of the President be sent on to the Executive Committee for consideration.

Mr. Cary : Couldn't that be on a sliding scale according to capitalization—so much for each thousand capitalization, then nobody would feel injured at paying too much.

Mr. B.F. Reesor : Doesn't that mean that a company could have a company membership or not, just as they pleased ?

The President : Yes, that was my idea ; it would be optional.

Mr. Reesor : The small company would send the same man every year ; the large company would pay a $25 fee and send two or three men, and change around occasionally.

Mr. H. O. Edwards : There would be a larger fee entitling them to a larger number of delegates ; the larger company would want to send more delegates than the smaller company ; the smaller company might have a smaller fee, entitling them to one, two or three delegates, and the larger company more.

Mr. Reesor : How would that be when it comes to voting ? The large company have three or four votes and the small company one ?

The President : I think in the National Association each company has one vote.

Mr. Cary : They are privileged to send any number of representatives, but only one official representative.

Mr. Leyden : It seems to me we are confusing two things, the fee that the company would pay for membership, and the amount that a company should con-

tribute towards the expense of the Association. I don't see that you can charge one company more than another for membership fee in any association. We should, it seems to me, have a fee which is reasonable and charge all the companies the same fee, and when we want to take up a collection to raise money for legislative purposes it will have to be done outside of that, and the larger companies necessarily will be expected to pay more than the smaller companies. I don't see how you could have a sliding scale for membership fees.

Mr. C. Doutre : There are companies who, at the present day, have two or three delegates whom, I presume, are individual members. It is going to be pretty hard to decide upon any equitable fee for company representation. There are companies who invariably send three or four delegates, and other companies will only send one, and those companies who send one will object to paying any company fee which would be considered equitable, because you could not put the fee down at any $3 or $5 basis ; they would overcome that by sending simply individual members. I think there is nothing to be gained by introducing a company membership fee, because those companies who object would simply send individual members, and those companies who have five or six parties they wished to send would pay the fee, which would be a nominal one, and the Association would lose by it.

Mr. Cary : I think there is one point Mr. Doutre has omitted. No company would be privileged to exhibit at the convention unless they were members of the Association as a company. If we bring that up to the proper level, any company that has any respect for itself at all will pay $25 for the privilege of exhibiting.

Mr. Gossler : As I understand your suggestion, the matter of company membership is simply to augment the membership of this Association ; it would in no wise eliminate individual membership.

The President : It is suggested as a possible means of reaching and interesting companies who now have no individual membership. It is moved by Mr. Yule that this matter be referred to the Executive Committee.

Mr. A. B. Smith : I second that.

The President : The Executive Committee would report to the next convention. It might be in the form of an amendment to the constitution.

Mr. Reesor : That would put it off for two years. You could put it in as a notice of motion.

The President : If we are agreed as to what we want we can put it in as a notice of motion, but I hardly think we have reached that point to know exactly what we want.

Mr. Gossler : There must be some means of putting that before the Association so that it will not take two years to act.

The President : I think we could put a notice of motion in general terms and we could arrange the details to suit ourselves.

Mr. Reesor : Put it in as a notice of motion and the Executive Committee in the meantime can deliberate and report at the next meeting.

The President : Article 10 of the constitution says : "Permission to introduce any notice of amendment or amendments to this constitution must be granted by a majority of two-thirds of the active members present. Permission being granted, notice may be given and the proposed amendment moved at any subsequent sitting. After discussion the amendment must be submitted to a committee of five, named by the chairman." There is only one motion before the chair, that by Mr. Yule, seconded by Mr. Smith, that this matter be referred to the Executive Committee.

Mr. Cary : Would Mr. Yule be willing to withdraw that and make the motion that the chair should appoint a committee. We are a little hazy, I think, on the constitution. What is your wish in the matter ?

Mr. Yule : I don't understand what you want.

Mr. Cary : To follow the constitution. The president says if he appoints a committee of five they can report to-morrow ; that won't postpone it for even a year.

Mr. Yule : I will withdraw my motion.

Mr. Reesor : The way I understand it you will have to take a two-thirds vote of the meeting to allow the constitution to be amended.

The President : Yes, there must be a two-thirds vote of the members present to grant permission to introduce the amendment. When the amendment is introduced I refer it to a committee of five.

Mr. Yule : I will take the original motion, that it be referred to the Executive Committee, and that they be asked to report at the next convention.

Mr. Wright : I would vote against any amendment to the constitution at this session ; it would not be advisable.

The President : I don't think myself it would be well to be too hasty about this, and probably if we could amend the constitution at the next convention it would be quite early enough. Will your motion stand then, Mr. Yule ?

Mr. Yule : Yes. My motion is that the recommendation in the President's address be sent on to the Executive Committee, and if approved of by them they report a scheme to the next convention.

The President : You have heard the motion, are you ready for the question ?

Mr. Gossler : I personally object to any proceeding that would require two years to make it effective. If we are going to get any benefit out of it, two years is too long.

The President : I think it can be done in one year.

Mr. Gossler : When is it going to be ? There will have to be ten members to form a quorum.

The President : Mr. Yule's motion is that the Executive Committee consider this question during the year and report some scheme at the next convention.

Mr. Leyden : I don't believe we fully realize the extent of this change that is going to be brought about by carrying this motion at the present time ; there are two kinds of societies, one of electrical engineers, the other a commercial society for the benefit of electric companies. At the present time we are in the happy position of being on both sides of the fence ; we have members interested personally and the companies interested personally. If you change that, if you make that a company representation, it is going to mean quite a vital change in this association, and I think it should be thoroughly considered by the members of the association before it is carried. The electrical men in the Dominion of Canada are none too many, and none too many of them are interested in the association to run the risk of any of them dropping out because their companies take the responsibility from them.

Mr. Cary : By referring it to the executive we have fulfilled Mr. Leyden's idea.

The President : I think so. I take Mr. Leyden's remarks to be in the line of the proposition by Mr. Yule.

The motion was then put and carried.

Mr. Wright : I understand your interpretation of the constitution is that it can be amended at the next meeting.

The President : There is no question in my mind on that article, it can be amended at the next meeting.

Mr. Wright : I always had the impression that it could not be amended at one session.

The President : We will have to refer this to the solicitor of the legislation committee. The report of the secretary-treasurer, which was read yesterday, as to the finances of the association, is before you if you have any remarks to make.

Mr. Reesor : I would move, seconded by Mr. Smith, that we adopt the report. Carried.

Mr. Reesor : I wanted to say something about the application for membership form. The way the form reads now is that a person joining the association joins for one year. I think when they join they should be considered as members until they send in their resignation. I think it should be made so that when I once join I am constituted a member, and I should be called on to pay my fees every year until I give notice of withdrawal.

The President : I don't think it is necessary to pass any resolution, but when the secretary gets new application forms, he should have that corrected. We will record it

in the proceedings that the secretary is instructed to do that.

Mr. Gossler: I wish to give notice of motion that at the next convention I will make a resolution whereby companies can be admitted to membership to this association, if the executive committee think it wise, or if the association think it wise, at the next convention. The object of that is that we can introduce company membership at the next meeting of the convention, rather than two years hence, if it is thought advisable. I think that this notice is necessary according to the constitution.

The President: I don't think it is, but I am quite willing to take the notice of motion in case there is any doubt. It requires a two-thirds vote of this meeting to give permission for this notice of motion to be recorded. Are you willing that we should receive this notice of motion? It is subject to the report of the Executive, of course. This is a precautionary measure to save time in case we want to make an amendment next year.

Mr. Gossler: The idea of that is that if it is decided at the next convention by the Executive that it would be desirable to admit companies to membership, we can take immediate action. It is not in any way to antagonize the action of the Association or of the Executive Committee, but it permits of more prompt action.

The President: Are you willing that we should receive this notice of motion?

Carried by two-thirds vote.

The President: The report of the Committe on Statistics is before you, gentlemen. For those who have not heard this report I may say that the report was to this effect, that considerable data had been collected, but no definite action had been taken by the committee during the year. What is your pleasure regarding this report?

Mr. Yule: I move, seconded by Mr. J. J. Wright, that the report of the Committee on Statistics be received. Carried.

The President: The report of the Committee on Meter Inspection is before you. This report is to the effect that during the year the committee has interviewed the officials of the Inland Revenue Department and obtained from them a concession regarding inspection fees to the effect that whenever a meter is inspected within the five years' period, namely, before the five years dating from the regular inspection are expired, 50 cents only will be charged instead of the regular fee.

Mr. Reesor: For any size of meter?

The President: Yes. You have the meter inspected and that inspection is good for five years. If after two years the meter requires readjustment and you have to break the seal and get it re-certified, you pay 50 cents fee instead of paying the full fee. This is in effect now.

Mr. E. Slade: Has any effort ever been made to abolish that fee altogether?

The President: No very determined effort has been made, because I think it would have been useless. I think anyone who has come in contact with the officers of the Department will know it is a useless undertaking. I don't say it could not be done in time, but at the present moment I don't think it would be possible.

Mr. W. Williams: I would move that the thanks of this Association be tendered the Meter Inspection Committee for their successful efforts so far, and that they try and do better, and endeavor to get that inspection fee blotted out altogether.

Mr. Sangster: I would second that. Carried.

The President: The next is the report of the Legislation Committee which was read yesterday.

Mr. Wright: There is only one matter in connection with that report that I think calls for special remark, and that is the suggestion that some method should be adopted to raise the funds in a more systematic manner, a more equitable manner, to meet the expenses of that committee. The electric light companies throughout the province of Ontario have benefitted very largely from the labors of that committee and from the expenditure that has been made, and they have responded, taking them altogether, in a first class manner to the demands that have been made on them for the expenses. But it seems to me a hand-to-mouth method of raising the funds to have to suddenly make a draft and say, here, you are expected to pay so much, without any explanation or any particular arrangement as to the proper method of collection. The report simply suggested that some method should be adopted by which these subscriptions could be brought in in a more systematic manner. That appears to be the only point. It has been suggested that the various companies should be organized perhaps something after the manner of the suggestion in the President's address, so that they will become, as it were, almost stockholders in this thing, and if all contributed, a very small amount from each would possibly suffice. If any arrangement of that kind could be made it would materially lighten the labors of the committee, and especially those of the Secretary-Treasurer, on whom the onus falls of making these drafts and collecting the subscriptions.

The President: This is a very important question. I had hoped the Legislation Committee would have had some scheme ready to submit to this meeting, because they are the ones who know, from their experience, how this thing is to be handled best. It is difficult for a member outside, who has had no experience on the Legislation Committee, to suggest a proper scheme.

Mr. Williams: Wouldn't it be possible to bring in the gas companies in this legislative business? I think they are interested just as much as we are. Of course, a great many of our companies are controlling both; but I am sure this last spring the gas companies were as deeply interested as electrical companies in certain legislation which might have been put through the local house, and I am sure that a number of the gas companies could be brought in and would willingly contribute their share, according to their capitalization or ability, towards permanently looking after legislation.

Mr. Yule: Two years ago, in my report on legislation, I suggested some scheme of this kind being adopted. My idea was that the thing should be sent on to the Legislative Committee and to the Executive, and, if they could so arrange it, that a canvasser could be engaged to visit all the companies and get them to sign an agreement to contribute a specific amount for five years. I think the work this committee has done is worth a great deal of money to the companies of Ontario; it has saved lighting companies hundreds of thousands within the last six months to those who would not have got a dollar if this Conmee bill had not been on the stutute book. It is quite apparent that legislation in the Ontario House has need of careful attention; if it is not attended to we will have trouble, and will get back where we were, and will not get out of there any more. There should be a strong effort made to get a system that will protect us and protect us well. I would move that this question be sent jointly to the Legislative Committee and the Executive Committee to develop a scheme along those lines, to get a canvasser or solicitor to visit all the companies and get them to sign an arrangement for five years to contribute a specific amount to relieve ourselves and relieve them of a good deal of worry and annoyance, and make the committee and their services more efficient.

The President: You wish to authorize the committee to do this?

Mr. Yule: The Legislative Committee would not like to take any action of that kind without the concurrence of the Executive Committee. I am throwing out that suggestion for the members to express their views on. Of course, this thing applies only to Ontario. In Quebec, fortunately, they do not have the anarchists and socialists that we have up here to bother and put the knife into them.

Mr. Reesor: In connection with that, you would have to talk ways and means if the two committees join and promulgate a scheme of some kind. I think it would be perfectly right to get a man to go around and get the companies to become members of the Association at the same time; but it costs money to send that canvasser around, and these committees

would have to have some ways and means at their disposal to send a man around, unless they were only going to report to the convention next year.

Mr. Cary: Question.

The President: The motion by Mr. Yule is to the effect that the executive committee and the legislative committee jointly consider this question, and be authorized, if they deem proper, to send an agent around the country to the different companies, to get them, if possible, to sign an agreement to contribute a fixed sum each year for five years, for legislation purposes. Is that your idea, Mr. Yule?

Mr. Yule: Yes. I don't know about sending a representative around, but let them consider some plan.

The President: Not necessarily that, but I understood you to say that, and as Mr. Reesor says, that is a matter of expense, and we must consider that feature of it.

Mr. Yule: I talked this thing over with Mr. Mortimer some time ago, and he says he will be sending a man around working in the interests of his journal. Probably we might get him to attend to it.

The President: I will make your motion simply to refer the matter to the two committees jointly without any instructions, and they will do what they deem best.

Mr. Yule: Yes.

The President: We cannot tie their hands very well.

Mr. Yule: No.

The President: We will take the motion this way, that the matter of raising money for legislation purposes be left to the executive and legislative committees jointly, with power to adopt whatever means they may deem proper. This motion is seconded by Mr. Williams. Are you ready for the question?

The President put the motion, which, on a vote having been taken, was declared carried.

The President: The next is the report of the Committee appointed to confer with the Underwriters. As this is a special committee, it will be necessary in adopting this report, to state whether you wish this committee continued or not.

Mr. Yule: I think the chairman of that committee expressed a desire that the committee be continued.

Mr. Gossler: Yes; it would be advisable to have a committee; not necessarily the same committee.

The President: The personnel, of course, could be changed.

Mr. Gossler moved, seconded by Mr. Smith, that the report of the committee to confer with the Underwriters be adopted, and that the committee be continued for another year. Carried.

The President: The next is the report of the Committee on Standardization of Accounts. This committee reported they had collected considerable data, and had had correspondence from different sources, and were still at work. I think we will have to adopt the report and continue the committee. Will anyone move that?

Mr. Wright: If the committee is still at work I would move they be continued, of course.

The President: They were at work up to the time of the convention; their work is not finished; they had no report ready.

Mr. J. J. Wright moved, seconded by Mr. Briethaupt, that the report be adopted and the committee continued. Carried.

Mr. Leyden: They promise a report for the next convention?

The President: I don't know who will compose that committee for the next year. If the same men continue I suppose they will.

Mr. Leyden: I understood the proposition was to continue the same men.

The President: To continue the same committee. The naming of the members will come later.

The President: The last committee is also a special committee for the purpose of defining some standard for arc lamps. This committee report progress, but their work is also unfinished. Shall this report be adopted?

Mr. Leyden: Excuse me; that committee was to report on a standard for arc lighting, as I understood. At the last convention we had a discussion, and there were several motions offered to define what is meant by a 2,000 c.p. arc lamp; and some of the motions were exactly according to the wording of the American Institute of Electrical Engineers, and the London Board of Trade, and all the authority that was necessary to give the thing a standard value, namely, that an arc lamp which should consume 450 watts to the arc should be considered as defining a 2,000 c.p. arc. I think it is all nonsense for us to continue in this way; if we are going to do business let us do business.

The President: If you had heard the report which was given yesterday you would have seen the reason the committee did not bring in a report. They did not give a final report. Their reason was this, that as there are so many different kinds of arc lamps now being brought out, is was difficult to make a cast iron wattage rating that could be accepted; and that as this question was in the hands of larger bodies, and engineering societies were still dealing with it, it would be premature for this society to express itself. That was the sense of their report. Does Mr. Gossler move that this report be adopted?

Mr. Gossler: I move the adoption of the report.

The President: Do you wish the committee continued?

Mr. Gossler: I don't know as it will do any harm, and it may be a great deal of benefit.

Mr. Gossler moved, seconded by Mr. Simmons, that the report be adopted and the committee continued. Carried.

The President: I will now call upon the Nominating Committee, appointed at yesterday's session, to report.

Mr. Mortimer: I have been asked to read this report. It is as follows:

For President: A. A. Dion, of Ottawa.

1st Vice-President: E. E. Cary, St. Catharines.

2nd Vice-President: P. G. Gossler, Montreal.

Secretary-Treasurer: C. H. Mortimer, Toronto.

Executive Commitee: First five—A. B. Smith, O. Higman, D. R. Street, J. J. Wright, B. F. Reesor. Second five—F. W. Simmons, A. Sangster, John Yule, Edward Slade, H. R. Leyden, Wm. Williams (Sarnia), J. F. H. Wyse.

Committee on Statistics: J. F. H. Wyse, J. A. Kammerer, A. A. Wright.

Committee on Legislation: R. O. McCullough, J. J. Wright, B. F. Reesor, C. B. Hunt, John Yule, H. R. Leyden, A. A. Dion, W. H. Breithaupt. (With power to add to their numbers.)

Committee to Confer with Underwriters: P. G. Gossler, Edward Slade, A. A. Dion, Alderman Sadler, A. Sangster.

Committee on Arc Lamp Rating: O. Higman, P. G. Gossler, Fred Thompson, John Yule, J. F. H. Wyse.

Committee on Meters: (Same committee continued).

Committee on Standardization of Accounts: (Same committee continued), Mr. Hart, chairman.

The first name on each case to be chairman of the committee.

The President: You have heard this report. You understand thoroughly that this is merely a suggestion on the part of the committee; it is done for the purpose of guiding the members and helping them in their choice; it is not binding on any member of the Association. Other nominations for any of the offices or committees are quite in order. The election of officers and the executive committee will be taken up to-morrow, but the other commiteees will be selected now. The selection of the Nominating Committee of a Committee on Statistics is Mr. J. F. H. Wyse, Brantford, Mr. J. A. Kammerer, Toronto, and Mr. A. A. Wright, Renfrew. Are there any other nominations for this committee?

Mr. J. J. Wright: I think in the case of this committe it is not open to change.

The President: It was my impression that the chairman had the nominating of the committee, but Article 18 of the Constitution says: "The president shall nominate a committee of three to strike the standing committees for the following year and define their

respective duties, the report of the committee being considered at a subsequent sitting to its introduction." That would mean to-morrow. This is an article of the constitution that has been ignored in the past. I think the President has appointed the committees on the recommendation of the Striking Committee, but to be on the safe side I would rather have the convention confirm the nomination. Is it your pleasure that the Committee on Statistics be as recommended by the Nominating Committee? Carried.

The President: The next is the Committee on Legislation: R.O. McCullough, J. J. Wright, B. F. Reesor, C.B. Hunt, John Yule, H.R. Leyden, A.A. Dion, W.H. Breithaupt, with power to add to their number. Does this meet with your approval? Carried.

The President: The next is the Committee to confer with Underwriters. The committee recommend Messrs. P. G. Gossler, Edward Slade (Quebec), A. A. Dion, Ald. Sadler and A. Sangster. Carried.

The President: The next is the Committee on Arc Lamp Rating. The committee recommend Messrs. O. Higman, P. G. Gossler, Fred Thomson, John Yule and J. F. H. Wyse. Carried.

The President: The next is the Committee on Meters. The same committee as last year is recommended: Messrs. A. A. Dion, E. E. Cary and J. J. Wright. Carried.

The President: The next is the Committee on Standardization of Accounts. The same committee as last year is recommended: Messrs. D. R. Street, P. H. Hart and A.A. Wright (Renfrew.)

The President: Mr. Hart has taken no action at all, and he has not been heard from for a number of months; I don't know where he is.

Mr. Gossler: He is down in the Lower Provinces.

Mr. Street: Although I was named first on that committee, Mr. Hart was chosen chairman at a subsequent meeting, on account of the paper he contributed to the association last year. I might say that the committee arose from the discussion on his paper and the appointment from that, and out of deference Mr. Hart was appointed chairman, and if he is going to continue a member of the association and a member of that committee, I, for one, would like to see him still chairman, although I see my name is mentioned first.

The President: The recommendation of the Nominating Committee is that the first name mentioned on each committee will be the name of the chairman.

Mr. J. J. Wright: That is according to the constitution; it is just as well to have the constitution defined. I think we are practically unanimous in accepting these committees. Article 19 says: "The first person named on any committee shall act as chairman until the committee is called together, when they will elect their own chairman."

Mr. Reesor: That should be that the first name on the committee should be the convenor.

Mr. J. J. Wright: If you take the article before that, and take that word "strike," it must mean to elect, not to nominate. It is a very ambiguous term. The considering of it would mean the announcing. If it is thought well to introduce any amendments to the constitution at the next convention, I would move that some of these articles be amended in a certain degree to make them plainer.

The Pretident: There are several amendments required. Mr. Street requests that the order of the names be changed on this committee, and that Mr. Hart's name be placed first. Are you willing to alter your report in that way? He wishes to have Mr. Hart continue as chairman because he was chairman last year and took the initiative in that.

Mr. Wright: I suppose the committe would have to be called together again to do that.

The President: It occurred to me that Mr. Hart took no action for some time, and he might not in the coming year. That would leave only two names. It might be advisable to add another name.

Mr. Street: I think it would be very wise.

Mr. Wright: Would you suggest a name?

Mr. Street: No, I don't think I can.

Mr. Smith: I would suggest Mr. Higman, of Ottawa

The President: I think some gentleman who has to do with central station accounts should be put on that committee.

Mr. Gossler: I think the matter as brought out by Mr. Wright is a matter that should be decided now, as the precedent that is being established here by the action of the executive placing before the association the committees for approval is, if I am not incorrect, contrary to custom. The constitution has been interpreted here to convey that the executive should receive the nominations for the committees, and then present them to the association. I think in all legislative bodies or all organizations that this is one of the privileges of the executive. Now the precedent has been established in this association for the executive to place those committees before the association for its approval. It seems to me that is contrary to precedent and custom, and I think we had better decide now whether we want to interpret the constitution to mean that of our own association and go contrary to custom, or stick literally to the constitution.

The President: It is very difficult to interpret this article, and for that reason I thought I wonld keep on the safe side by getting the approval of the meeting.

Mr. Wright: But you establish a precedent which might be inconvenient at some future time.

The President: The article says they shall "strike"; if you take that to mean they shall "elect," what is the use of considering their report at a subsequent meeting?

Mr. Wright: That is probably antagonistic to the other word.

Mr. Yule: I think the meeting would have power to amend the committee's report in any event.

Mr. Gossler: I don't think so, unless there was an illegal appointment. Is it not customary for the executive to have the power of appointing committees in organizations such as this?

Mr. Wright: That certainly is the custom; it is thoroughly well safeguarded, and the very fact that the President may nominate a committee of three clearly shows that. Now, of course, he is given the initiative in the first place; he can select three men whom he thinks will nominate and strke the committees rightly in the interests of the association; then there is the further safeguard that three good members of the Association would not in all probability strike committees that are not in the interests of the Association. The President takes the initiative; the three men then strike the committees, so there is a safeguard there between the executive and the three members of the committee; at the same time it does not leave it open to be all torn to pieces by the association generally.

The President; Article 21 says Todd's Parliamentary Practice shall govern.

Mr. Reesor: As far as I understand the parliamentary practice, I think the select committee strikes the standing committees; the standing committees are then reported to the full body and usually they are adopted, but it is not imperative; the whole council can tear them to pieces or add to them I think the select committee have the nominating of them, and it is the usual practice, but not imperative, to adopt them.

Mr. Gossler: I understand a motion could be introduced whereby the committee could be increased in numbers.

The President: So far there has been no amendment. The committee have been accepted just as they are. But I have asked the Nominating Committee to amend their report themselves by adding a name to the Committee on Standardization of Accounts. If they consent to do that all right. In any case, no objection has been taken to any of those committees.

Mr. Wright: That is not the question; it is simply to define the article in the constitution to avoid any further trouble. According to article 10 of the constitution we are empowered to amend this constitution at this session, so I will give notice of motion, with the consent of two-thirds of the members present, that this word "consider" in Article 18 shall be changed to "announce." This, of course, will be considered at tomorrow's session.

The President : Do you consent to receive this notice of motion ? I think we might leave this matter of amendments until our next sittings, to allow the members to become familiar with the articles.

Mr. Wright : If we do that it prevents any amendment being made at this session. It is really unimportant, as far as that goes ; there is nothing hinges on it now, but at the next convention there might be something very important come up. If it is thought more advisable a small committee might be appointed to revise the whole constitution and report at the next convention.

The President : I think so. I have had occasion to refer to this constitution during the year, and I think it is very incomplete.

Mr. Williams : I don't think the amendment, with the present constitution, would be got through this session any way ; it requires, after permission being granted, after discussing, that the amendment be submitted to a committee of five named by the chairman ; the report of the committee cannot be considered on the same day on which it is introduced. If you take your notice now you can't do anything till to-morrow ; to-morrow you would refer it to a committee which could not report.

The President : It would be necessary for the committee to report this afternoon, and we could not take it up till to-morrow.

Mr. Breithaupt : I would move that the chair appoint a committee of three to look into this matter and report at the next meeting, if possible, or to-morrow morning.

The President : If they report to-morrow morning we cannot consider it at this session.

Mr. Wright : Would you refer the matter to the Executive Committee to bring in a recommendation at the next convention ?

Mr. Breithaupt : The only reason why I mentioned three is because the executive is rather large, and three would be better able to get together and do the business. I am willing to change it to the executive if Mr. Wright thinks so.

Mr. Wright : It is a question for the majority of the members.

The President : Unless it is reported upon to this convention this afternoon, we cannot consider that at this convention.

Mr. Breithaupt : If that is not the proper interpretation, we might have a motion that it be left to the next session, and the change then be adopted. I would move that.

The President : It is moved by Mr. Breithaupt, seconded by Mr. J. J. Wright, that the Executive Committee be requested to suggest necessary amendments to the constitution at the next convention of the Association. Carried.

The President: The next order of business is the reading of papers.

Mr. Smith : Before that, I would like to move that the usual grant be given to our secretary as last year.

Mr. Leyden : I second the motion.

The President put the motion, which, on a vote being taken, was declared carried.

The President : I would call on Mr. Camp to read his paper on "The Use of the Dynamo and Storage Battery in Telegraph Offices." (See page 170).

Mr. Camp : Before reading the paper I would like to call your attention to an error made in fig. 2 of my paper ; it was a mistake on my own part. You will find by one of the circles designating dynamos on the left hand side, it is marked "negative 350 volts" ; this should read "positive" ; the next one should read "negative 350 volts." The four circles should be lettered m,n,o,p, commencing on the left hand side. It is necessary, in order to understand the inspection of the diagram.

The President : You will agree with me that this is a very excellent paper on the subject. It has always been a difficult matter to get papers on telegraph subjects. This time we have secured a valuable one, and the subject is fully and well treated. The telegraph business, while comparatively an old branch of the electrical science, is, as we may see by the descriptions given by Mr. Camp, by no means at a standstill, but developing rapidly as the other lines of electrical application. The paper is open for discussion.

Mr. Camp : I would like to hear some expression from Mr. Smith on this subject. I certainly expected to have his experience ; he has probably been more largely concerned in working dynamos as applied to telegraphing than I have. It is only in the present year that we have installed our own plant in Toronto. I think he could give a good deal more information on the subject than I have.

Mr. Smith : Mr. Camp's paper does not admit of much discussion ; he has covered the ground so thoroughly and so concisely that there is nothing left to be said. As an historical paper, we are very glad to have it for the Association. We have nothing of its kind in our papers, and having this from Mr. Camp, who is so well qualified to write, we are glad indeed to have it. In speaking of our experience with dynamos and motor generators for telegraph work, I have a very vivid recollection of the first machine made ; I think it was in 1882 it was brought out, and I think Mr. Wright had a good deal to do with it, and when the machine was first connected up, we stood by in fear and in trembling wondering what it was going to do, and finally the thing seemed to go off allright, and out of that developed the two large motor generator plants we now have in use in Toronto and Montreal. Subsequent development and improvement in the storage battery developed the fact that they are superior to the motor generator for most classes of work, and would to-day be adopted, I think, in all the larger places. I would move a vote of thanks to Mr. Camp for his paper.

Mr. Wyse : I second that.

The President : I have much pleasure, Mr. Camp, in tendering the thanks of the Association to you for your valuable paper. Yesterday we had a paper on power factor on which there was a little discussion, and the further discussion of it was adjourned until to-day. I would like to hear from any members on this subject. I think it is a very excellent paper which should be discussed.

Mr. Gossler : I suggest that you call on Mr. Leyden for an expression of opinion. He has had considerable experience in the use of induction motors, alternating current arc lamps, and synchronous motors, and is, I am sure, very well qualified to speak on the subject.

The President : We should be pleased to hear from Mr. Leyden, I am sure.

Mr. Leyden : I have not had an opportunity to read over this paper of Mr. Leonard's with any care, and anything that I can say would just be a sort of general expression of what my opinions might be, and I don't know whether they would be covered by Mr. Leonard's paper or not. The only thing I can say is this, that the keeping of your power factor, particularly at certain hours of the day, as high as possible, is of very great importance to the operation of your station, especially where you are supplying incandescent lights from the same generators as you are the motors and arc lights. It becomes a question that you have to figure on, on almost every installation of motors and lights and everything you put in, to find out and anticipate as nearly as possible what its effect will be on your whole service. On the other hand, the question of putting in induction motors and alternating arc lamps on your circuits has so many manifest advantages that you can afford to put up with some of the disadvantages in order to obtain the cheapness and reliability of operation that you certainly do secure by these means. On our plant we are changing all our arc lighting service over from direct current to series alternating current for our street lighting. So far, we have changed about half of it to series alternating current enclosed arcs. The power factor of that we find varies to a very considerable extent, according to the number of lamps we put on our circuit, but as far as the reliability of our service or economy of operation is concerned, it is all that we anticipated when we adopted that method. As compared with the series open arcs which we had

before, it certainly saves a very considerable percentage in the amount of power it takes in your lighting service ; it also saves you a very considerable expense in the operation of your circuits ; by that I mean both the expense of trimming, the expense of carbons and the expense of maintenance of the arc lamps. The series alternating arc lamps that are on the market to-day are quite simple and reliable in operation and cheaply repaired. We have had perhaps six months' experience with series enclosed arc lamps. While, of course, you necessarily have your troubles in any electric plant, you have nothing at all serious. The effect of this power factor and of these alternating arc lamps on the rest of your service amounts to about this, we have made a number of tests on our arc lighting circuits, and we found that our power factor will vary according to the number of lamps that we connect on that circuit. If we get all the arc lamps on that the circuit will possibly carry, we get a power factor of about .85, and it drops down very rapidly as you take arc lamps off your circuit. We run a pressure of 2,400 volts ; on that we should be able to burn, theoretically, some 33 arc lamps, series enclosed ; if we got the full 33 on, I think we would have a power factor of somewhere about .90 or .91, but we find that the circuits won't work well when we put the full number on, and we get more satisfactory operation by cutting it down to about 30 ; that has also the effect of reducing your power factor down to about .85. So it is a question you have to consider on both sides, whether you can put up with the annoyance of this power factor in order to save the expense of operation of your plant. I think the expense which you do save and the economy which you gain, and the simplicity of your system, certainly overbalances any evil effect of this low power factor, especially when you take into consideration that at certain times of the day when this power factor annoys you most, by having some synchronous motors on your line you can to a large extent over-balance it. Synchronous motors in large sizes I consider to be a very valuable, very handy, and convenient piece of apparatus to have on your circuits. This is especially true for motors which you must have in your own premises and under your own care, where you can regulate and operate them to the best advantage, or in places where you have some control over them through the attendant who operates them. On the other hand, my idea of small motor work is that the induction motor is much simpler ; and while it has a low power factor in a great many cases, particularly on partial loads, still it is a commercial problem, and you have to balance one advantage against the other ; and generally speaking, the result of our experience is this, that in large motors, and particularly where you have steady loads, I should employ synchronous motors ; where you have distributed power in a factory where you want to divide it up into small units, the manifest mechanical advantages of the induction motors predispose me in their favor. I am talking in this general way because I have not read Mr. Leonard's paper with sufficient care to take it up in any detail.

The President : Might I ask a question or two. Apart from the lowering of the power factor induced by the use of alternating arc lamps, are they a disturbing element on your circuit to any extent, assuming you are running incandescent lights off the same generator ?

Mr. Leyden : No, I should not say that they are. We cannot notice any effect of these arc lamps on our service in general, any more than, well, not as much as you would by starting a motor up to drive a lot of arc machines ; that is, we throw one arc light circuit on after the other at the time of starting ; the effect on our service of that is less noticeable than would be the effect of starting up a large motor to drive a lot of arc machines, and the attendant at our power house has to be watching his business, and gradually raise his field current on his generators in order to compensate this. By careful attention on the part of the swithboard attendant, he can put those arc lights on so that there is no serious interference with our incandescent lighting. I presume if we throw all those arc lamps, say 500 series alternating arc lamps, on at once, it would produce quite a very marked disturbance, but we don't notice it in our present system.

The President : Another thing I wished to ask is whether, in the case of synchronous motors used on your circuits, or more especially in your station within your control, whether you can regulate them day in and day out, as a general thing, so as to counteract drop, whether that is a practical quality of the motor that you can do that regularly.

Mr. Leyden : I should say that would depend to a very great extent upon the character of the load on your synchronous motor. If you have a rapidly fluctuating load, I have found the only way is to set your field current so high that it cannot be pulled out of step by any of the sudden jerks that come upon it, and let it run at that. If your load is steady all the time, you undoubtedly can operate that synchronous motor to very great advantage to the rest of your service. At the time that your power factor is low, and you set the field current on high, it will compensate for a great deal of the lagging current on your other service ; and I should say that in most cases where you have synchronous motors the loads are steady, and under those conditions you can operate a synchronous motor so that it is of very marked benefit on the rest of your service.

The President : Have you anything further to say on the subject, Mr. Gossler ?

Mr. Gossler : I don't know that I have anything further to say on the subject ; it is pretty broad, and a subject that could be talked on for a very long time, but I don't think I will say anything on it now.

The President : How about Mr. Leonard ?

Mr. Leonard : I have very little more to say. In what I said yesterday in my paper, and the discussion we had yesterday afternoon, I think I have expressed myself pretty fully. But it has certainly pleased me very much to hear from Mr. Leyden, as it brings a class of information to central station managers which is just exactly what we are looking for; particularly those that are either in the power business at the present time or contemplate going into it ; and I wish the discussion could have been a little broader. I was very much interested in what Mr. Leyden said about arc lamps ; it is a matter whice I have not personally had a great deal of experience with, but I think it is one of the branches in connection with alternating stations which is certainly going to be a matter of a good deal of importance. They are trying to simplify our stations to the utmost, and we may some day realize the ideal of a single type of generator, as I said in my paper, with interchangeable parts, and one type of reserve apparatus—everything in shape—so that an accident is not going to cripple the whole system. Besides these advantages, there is the advantage of the reduction in expense of operation. I think the arc lights can be operated at very much less cost in connection with a large alternating current generator, as compared with the necessarily small direct current machines. I don't know, Mr. Leyden, what system of compensation you are using. Is it the choke coil type of apparatus ?

Mr. Leyden : Yes, the choke coil.

Mr. Leonard : I think I have nothing further to say.

Mr. Sangster : I may say one year ago about this time we adopted the series alternating enclosed arc lamps in our station ; we didn't put in very many of them, about 90, I think, at that time, and we found them very satisfactory indeed. We purchased them from the General Electric Company, and we are using the transformer. We can put on 12 or 15 lights on the line and it does not seem to affect it in the least. We sometimes have to do that. We have two lines, 45 on one, and 47 on the other, using about 80 volts each, and we find it very satisfactory, both as to expense and care of the lamps and the general maintenance and cost, generally running one week on half a carbon ; one carbon does two weeks. And we find it an advantage in every possible way. As far as the

power is concerned, I really think it does not seem to take any more power than we were using on the straight current before, and I think that station managers should look into this a little more. Of course, there is no doubt they are improving on the lamps every day.

Mr. Leyden: There is an interesting part of this alternating arc lamp business that does not pertain exactly to the subject of this paper, but I think it would be of interest to the members of the Association. There seems to be considerable talk, and there has been for a number of years, amongst the electrical fraternity, about the inefficiency of an alternating arc lamp as a light-giving device; that is, a great many prominent electrical engineers and scientists tell us that you don't get as much light out of the alternating arc light with the same consumption of watts as you do out of the direct current. However that may be, I have become thoroughly convinced that for the same number of watts consumed in an alternating enclosed arc lamp, having a proper reflector above it, that you get a more satisfactory street illumination than you do out of the old-fashioned open arc lamp, direct current. We have had them in Hamilton burning since last Christmas, and we have not had one complaint about the amount of light or the quality of it; on the other hand, we have had a great many people compliment us on the greater satisfaction of illumination that we have. We find this, that while the light apparently directly underneath the lamp is not as bright as with the old open arc, yet it is even and no shadows; it is evenly distributed around underneath the lamp, and up and down the streets you will find a more even distribution of light, and after you get off, say beyond 100 feet, there is apparently more light on the street than there is with the old arc lamp; so that the difference, particularly in the amount of light, is not noticed; that is, there is no dissatisfaction with the amount of light by putting in these series enclosed arc lamps. There is another advantage which is quite marked, that is, that you can hang them low down, close to the street, and in that way increase the apparent illumination on the street without having any blinding effect on the people looking directly at them. The source of light is apparently so much larger that you can look right at the lamp without being blinded, and people can drive under the lamps and see where they are driving, which is not the case with the old arc lamp. I mention that as a point which is often brought up against the use of these lamps.

The President: I would like to hear what has been Mr. Sangster's experience on that—whether there has been any complaint by the people as to the difference in the light.

Mr. Sangster: I would say that the remarks Mr. Leyden has made would apply, that it is the same with our city. We can lower the lamps and the light is diffused much more than with the open arc lamps. They like it much better. We get the light more direct with the open arc, but the enclosed type seems to diffuse the light much better and people are generally much more pleased with the lights since we put them up, and every day we hear expressions as to how nice it is to what it used to be, and yet we had a very good light before in our open arcs.

The President: Do you have choke coils on in the station?

Mr. Leyden: Yes, we have them in our station.

The President: That means a good deal of wiring—many circuits.

Mr. Leyden: We had our circuits divided up practically in the same way as before, so that it didn't mean much difference to us.

Mr. Leonard: I was going to ask Mr. Leyden what his opinion was of operating arc lamp circuits with the transformers or choke coils distributed around on different parts of the circuit, as to whether there is any indication in his experience that such an arrangement would be objectionable in any way? Can the transformers, in other words, be relied upon to perform the work laid out for them without any attention whatever?

Mr. Leyden: We don't use the transformer method in our service, so I am not prepared to speak, but in a number of places I have visited where they do use that method, they have them distributed in that way; instead of having the transformers right in the station they are put out in vaults around in different sections of the city, and then they have an arc light inspector whose business it is to go there and start them up and look after the lights while they are burning, and if anything goes wrong it is his business to return to this vault and see what has happened. In my own experience I don't know whether it is advisable or not.

Mr. Sangster: We have not had any trouble with the transformers in the station; we have just two lines running out from them, a line from each transformer, and they are supposed to carry 50 lights, and as I say, it is very satisfactory; 12 or 15 lights put on we do not seem to notice—it seems to pick up so quickly.

Mr. Reesor: I would move that a hearty vote of thanks be extended to Mr. Leonard for his very able and useful paper. I think it is one of the best papers we have had read at our conventions yet. (Carried.)

The President: I have very much pleasure in tendering to you, Mr. Leonard, the thanks of this Association. The paper is not only a very good one, but the discussion which it has provoked has proved most interesting. As you said a while ago, that is the kind of information that central station men want at the present time, and therefore what has been said to-day has been of value, I am sure, to the members of the Association.

On motion of Mr. Reesor, the convention adjourned to meet at 2:15 o'clock p.m.

AFTERNOON SESSION.

The President, in the chair, called the convention to order at 2.30 o'clock, p.m.

The President: The next order of business is the paper by Mr. Blair, of the Quebec Railway and Lighting Company, of Quebec, on a railway subject.

Mr. W. H. Browne: I would ask leave to move to amend the regular order of business and substitute therefor the election of officers. I understand that the Nominating Committee have their ticket prepared to offer, and action can be taken upon it very readily and we can dispose of that part of our business. I ask for a seconder.

Mr. Ross: I second the motion.

Mr. J. J. Wright: Would it be competent to change the order of business to that extent? The day is set apart in the programme, and it has been the usual custom to elect the officers on the morning of the last day. Any member of the Association who is unable to be present now, and could be present to-morrow, might reasonably take exception to altering an important part of the proceedings in that way. Not that I think it will make the slightest difference to the election, but simply as a matter of proceedure.

Mr. Browne: I made my motion with full knowledge of the fact that that order of business was down for to-morrow. I did not understand that our order of business was the matter of a day. I thought it was competent for us to move for the amendment of the order at any time, and, believing the matter of nominations is practically all settled except the formal act, I thought it would save that much time.

Mr. Leyden: The object of this motion, I believe, is to arrange matters so that we can finish up our convention this afternoon, instead of carrying it over until to-morrow morning. We have only a small amount of business to transact, and one paper, I believe, to read, and if we could get through this afternoon there is no use carrying it over until to-morrow.

Mr. Wright: I think there is not the slightest doubt but that the business of the convention could be well and satisfactorily arranged this afternoon, but the city of Kingston have invited us here, and have entertained us most hospitably, and I think it would be very derogatory to them, and would appear to me to be a slighting of their reception, if we come here with the intention of holding a three days' convention and at the end of the second day we turn the whole thing up and go home.

Mr. Browne . I had better perhaps express myself more clearly concerning my motion. I did not know it was necessary to explain why I wished to change the order of procedure. I understand there are several members here who would like to adjourn this afternoon in order that they may still further enjoy the hospitality given by the city of Kingston, and then resume business to-morrow morning, and it was with a view of giving effect to that that I made my motion for the election of officers now.

The President : The holding of the election of officers now, to be followed by an adjournment until to-morrow morning, would practically close the convention.

Mr. Browne : There is another paper to be read.

The President : I know, but the attendance would be small ; I am afraid there would be a general exodus of the members.

Mr. Wright : If there is any special reason for adjourning this afternoon, if they wish to take up something else this afternoon, it would be quite in order to adjourn this session of the convention till to-morrow morning, and take up the business then, but I think it would be considered a very impolite act to close the convention to-day and go away. I do not mean to say it would make the slightest difference financially or in any other way to the city of Kingston, but when people have done their best for us and given us a good time, I do not think it is exactly the thing to pick up our traps and leave.

The President : I may say, in justice to the citizens of Kingston, that they have offered us a visit to the penitentiary to-morrow afternoon, and asked us to attend the military tatoo given by the military band to-morrow evening.

Mr. Browne : The main purpose for making the motion for the election of officers by me to-day, is that I am told it will be practically unanimous. There will be left then for to-morrow simply the matter of reading the paper and the discussion of it, without any interference with it whatever, and the great desire of the majority this afternoon is to adjourn and take a visit on the river again.

The President : If there are no further remarks we will take the sense of the meeting.

Mr. Leyden : That being the case, I would most strenuously object to holding the election this afternoon. They have been scheduled in the programme you have sent out to be held to-morrow, and it has always been the usage of this Association that we should hold our election on the last day. I do not see any use of bringing them on now if you are going to continue the convention to-morrow morning.

The President : The motion is to take up the election of officers. Do you move an amendment ? It is a question on which I feel rather embarrassed, because, while the convention can order me to do whatever they like by a majority vote, I feel that I have a contract to fulfil here and a programme to follow, and whatever is decided, I would like to be decided by a very large majority, if not a unanimous one ; in fact, I would rather have it unanimous and then we could share the responsibility together. I do not believe, though, that there are any members who are not here today that will be here to-morrow morning, so that it will really make no difference. Are you ready for the question, gentlemen ? We will now put Mr. Browne's motion that we should change the order of procedure, and take up the election of officers now.

The vote being taken, the President declared the motion carried by a majority of two.

Mr. Leyden: I move, seconded by Mr. Wright, that we adjourn until to-morrow morning.

The President : This motion cannot be discussed.

The President put the motion, and, on a vote having been taken, declared the motion carried, seventeen voting for and ten voting against the motion.

At 2.45 the convention adjourned until Friday morning at 10 o'clock a.m.

At 3 o'clock p.m. the members of the Association and their friends left on the steamer New York for a trip amongst the Thousand Islands, proceeding as far as Alexandria Bay. A unique feature of the return trip was the assembling of the members, at the call of the president, in the dining room of the steamer at 7 o'clock p.m., at which time Mr. Blair read his paper entitled "A Railway Subject, Giving Several Curves Showing up the Average Power During a Day, and Maximum and Minimum Requirements for Power Called for on the Quebec System." (See page 179.) The reading of the paper was greeted with applause.

Mr. Wyse : How long has the road been operated ?

Mr. Blair : Three years. The heaviest wire on any commutator is three-eighths of an inch.

Mr. Wyse : Is your traffic heavy as well as your grades ?

Mr. Blair : On those grades it is ; the heaviest grades carry the heaviest traffic in town. There has not been a commutator flash or buck on the road for eighteen months. The water and slush in the spring time have never given us any trouble, it is the hard snow in the winter. $16,300 is the total cost chargeable to snow. I may say in our company we have no depreciation account, everything goes in to maintenance account.

Mr. Wickens : Depreciation and cost of repairs go in together.

Mr. Blair : They go in together.

Mr. Browne : That is, you keep the road up to the standard ?

Mr. Blair : Yes, up to the standard for railways.

Mr. Wyse : Do you actually have to cart the snow away ?

Mr. Blair : In some cases we have to actually cart it away to some convenient place for the time being, and then the next day take it away permanently.

Mr. Wyse : Then you have to cart it twice ?

Mr. Blair : In almost every case we have to cart it twice. In some cases, without exaggeration, there are four feet of snow above the top of the car ; that, of course, has got to be shovelled out. A car will run into these drifts. Anybody who knows Quebec will know the point I refer to, Chateau Frontenac.

Mr. Wyse : Where do the foot passengers go ?

Mr. Blair : They have to come in along the car tracks.

Mr. Gossler : You pay the tenants fifteen cents per lineal foot for the removal of the snow how often ?

Mr. Blair : Once a year.

Mr. Wickens : What is the length of your day ?

Mr. Blair : Eighteen hours.

Mr. Wyse : The power supply is water power, is it not ?

Mr. Blair : Yes.

Mr. Wyse : What do you use the rotary converter for ?

Mr. Blair : For the railway at St. Anne-de-Beaupre, five hundred volts are fed into the wire. I may say there are eighteen stops made in twenty-one miles. We have as many trains on now as we can put on in that section. They will, in all probability, have another line laid in the near future.

Mr. Edwards : What kind of brushes do you use ?

Mr. Blair : We use the Valley Whiting.

Mr. Wyse : What pressure do you put on each brush ?

Mr. Blair : That depends on which car it is. We keep the hill cars and level running cars separate on our road.

Mr. Wickens : You run the same car over the hill as on the level ?

Mr. Blair : Yes, but we are drawing more current than on the level.

The President : I want to say, gentlemen, in justice to. Mr. Blair, that he advised the committee on papers a very short time ago that his paper was not written, and owing to pressure of work he was not able to write it, and the chairman of the committee on papers consulted me and we concluded that as we had decided to have a paper on a railway subject, and as it was too late to ask anyone else to write it, he should insist that Mr. Blair should write this paper. This seemed to be a little cold-blooded, but the interests of the association required it, and we were firm, and to our great satisfaction Mr. Blair replied that he would write it. That is not more than a couple of weeks ago, and this work has been done since, and we are certainly very much indebted to Mr. Blair.

Mr. Wyse : You must have a good method of keeping records.

Mr. Blair : We keep records of everything.

Mr. Wyse : You keep the records by numbers ?

Mr. Blair : By numbers of the car and so forth. The men who do the work keep the records during the month, and I take the whole of them and enter them in my own book once a month.

The President : That shows the value of keeping records.

Mr. Browne : It shows the value of systematic attention and records. I certainly think the thanks of the association are cordially due to Mr. Blair, and I move that a vote of thanks be passed to him.

The President put the motion, which, on a vote having been taken, was declared carried, and the thanks of the association tendered to Mr. Blair.

THE BANQUET.

The large dining hall of the Hotel Frontenac was none too large to accommodate the members of the Association and invited guests who assembled on the evening of August 30th to participate in the annual Association banquet. Mr. A. A. Dion, the President, presided, and gracefully discharged the duties of toast-master.

After the singing of the National Anthem in response to the toast to Her Majesty the Queen, the United States Vice-Consul, Mr. Twitchell, was asked to respond on behalf of the President of the United States, which he did in an able and interesting manner. Mr. Wm. H. Browne, in a pleasing speech, replied on behalf of "Our Association." Excellent speeches were delivered by Mayor Minnes and Alderman Donnelly on behalf of the "Corporation of Kingston." The names of Messrs. Simmons, Nickle, and ex-Alderman Behun were associated with the toast to "Our Guests." The toast to the "Allied Interests" drew eloquent replies from Messrs. M. H. Folger and E. E. Cary. Mr. Pense, editor of the Kingston Whig and President of the Board of Trade, responded for the Press, and Mr. Shannon, city clerk, formerly editor of the Kingston News, for the Ladies. Alderman Donnelly favored the company with a recitation, Alderman Craig contributed a song, the local military band and the Italian orchestra, engaged by Mr. Cary, each contributed a number of pleasing selections.

THIRD DAY.

At 10 30 o'clock a.m. the convention resumed.

The President : The first thing on our programme this morning, to carry out the resolution passed yesterday, is the election of officers. The Nominating Committee have reported yesterday suggestions as to the election, and I wish to repeat that suggestions made by the Nominating Committee are in no way binding on any of the members, but nominations can be made and received for any of the offices or the committee. The first office is that of President, and the Nominating Committee have recommended your humble servant. (Carried.) For First Vice-President the Nominating Committee suggest the name of Mr. E. E. Cary, St. Catharines. (Carried.) For Second Vice-President, the committee recommend Mr. P. G. Gossler, Montreal. (Carried.) For Secretary Treasurer they recommend Mr C. H. Mortimer, Toronto. (Carried.) With regard to the Executive Committee, as you know, five of the old members are to be re-elected, after which five more members are elected. Of the old Executive Committee the Nominating Committee wish the following to be retained : Messrs. A. B. Smith, O. Higman, D. R. Street, J. J. Wright, B F. Reesor. Carried. Now there are five other members of the Executive who may be chosen from any members of the Association. The committee suggest Messrs. F. Simmons, A Sangster, John Yule, Ed. Slade, H. R. Leyden, W. Williams, and J. F. H. Wyse. There are more names suggested than we require ; we only want five names to complete the list. I presume from this that the Nominating Committee wish us to make a choice from these names.

Mr. Ross : I nominate Mr. Camp, of the C. P. R. Telegraph Co., Montreal.

The President: I would ask Mr. Purcell and Mr. Reesor to please act as scrutineers. Are there any other nominations for the committee before we close it? Those going out on last year's Executive are Messsrs. Carrol, Black, Sangster, Wyse and Browne. Mr. Sangster and Mr. Wyse are proposed in this list.

Mr. Wyse: Would it be in order for me to nominate anybody else? If so, I would like to nominate Mr. Browne.

The President: I have no objection. I want to give the fullest freedom possible.

Mr. Wyse: Then please add the name of Mr. W.H. Browne.

Mr. Cary: I hope it will not be improper to call to your mind a short speech that was made at the banquet by Mr. Simmons. Some of you may not recollect it, but those of us who have endeavored to do a little here before the convention in Kingston realized that we could not get help for love or money, could not get plumbers, decorators, or anybody. Mr. Simmons took off his coat and worked like a day laborer. We wanted him to use his wits, but he had to use his hands. I feel that, if you all know the value of his services, you will only be too happy to put him on the Executive. And, in addition to that, he lives near Ottawa for the next year.

The President: While the ballots are being counted, we might improve the occasion by taking up the selection of a place of meeting.

Mr. Wyse: I would suggest that Ottawa be the place for the next meeting, and the approximate date as soon after the adjournment of parliament there as possible.

Mr. Leonard: I second that.

The President: Do you wish to have the date in the motion or leave that separately? There might be some discussion as to the best date.

Mr. Wyse: Keep that separate.

The President put the motion that the convention be held in the city of Ottawa next year, which, on a vote having been taken, was declared carried.

The President: I wish to say this, that I am very much pleased indeed that the convention should be in Ottawa. I didn't make you any formal invitation or press you to come to Ottawa simply because I thought that, having done so once and not being able to carry out the programme, we should not stand in the way of any other place which would like to get the convention or which was entitled to it. I wished, while we were desirous of having it in Ottawa, that the suggestion should come from outside, as it did. That was my reason for not extending to you an invitation. But let it be understood that we are very happy to have you come to Ottawa, and we will do our best to entertain you and give you a good convention. As to the date, Ottawa is peculiarly situated in that way. The sessions of parliament bring many to the city, and it taxes the hotel accommodation to the utmost, and during the last few years the sessions have extended far into the summer. Parliament adjourns late in June and sometimes well into July; for that reason the old favorite date, about the end of June, could not hold in Ottawa. I don't think it would be safe to select any date previous to the 15th of July. I think any time from the 15th of July on would be acceptable to us in Ottawa. It would be a matter of which would be the most convenient date for the members to get away. We might hear some expressions of opinion on that point.

Mr. J.J. Wright: I would move that the matter be referred to the Executive Committee, having in view what you say.

Mr. Kammerer: I second the motion.

The President: I would like to see the Executive Committee tied up as to the time when they must decide, so that there will be no possibility of leaving it till the last month. The date should be published months before.

Mr. Wyse: The constitution provides that the date should be approximately fixed now.

Mr. Wright: I think "approximately" would mean as near after the prorogation of the House as possible. I think that was understood.

The President: That is a question. It might be desirable to wait and have it later.

Mr. Wright: It would not be earlier than the end of June, that is the usual time we should have the convention, and it should not extend later than the middle of July. The present time is a most inopportune time to hold a convention in my opinion, but, of course, force of circumstances compelled us; but any time up to about the middle of July would be a suitable time.

The President: There is nothing in the constitution about the approximate date.

Mr. Street: Article 19 gives it.

The President: The only motion before the chair is that by Mr. Wright, seconded by Mr. Kammerer, that the fixing of the date be left to the Executive Committee. (Carried.) If there is any general business we might go on with that.

Mr. Yule: I would like to put before the meeting this resolution:

"Resolved that the hearty thanks of the Canadian Electrical Association be extended to the Mayor, corporation, and citizens of Kingston, the president of the Board of Trade, Kingston, the Kingston Street Railway Co., the Kingston Electric Light Co., the local committee, composed of Messrs. F. W. Simmons, Breck and Nickle, and the warden and officials of the Kingston penitentiary, for the hospitable and courteous treatment accorded to the members of the Association, and to the gentlemen of the press for their full and correct reports."

Mr. Yule: I think I am voicing the sentiments of the members when I say that Kingston is an ideal place for a meeting of this kind. They have the facilities, and they apparently have the heart to entain, and they have done it most excellently. I do not know that we have ever visited a place in which we have received more general recognition and more kind and courteous treatment. I have much pleasure in moving the resolution.

Mr. Kammerer: I have much pleasure in seconding the motion.

The President: I presume the motion is carried. The election results in a tie. I may say that Messrs. Simmons, Browne, Camp and Yule are elected. There is a tie between Mr. Leyden and Mr. Slade. You will kindly vote again on Mr. Leyden and Mr. Slade.

Mr. Kammerer: While the ballot is being prepared for this I would ask that you request Mr. Yule to retire for a few moments.

The President: Mr. Yule, will you kindly retire?

Mr. Yule having retired, it was moved by Mr. W. H. Browne, Montreal, seconded by Mr. J.J. Wright, Toronto, and resolved, that more than a year having elapsed since the inauguration of the legislation procured by the Legislative Committee for this association under the guidance and leadership of our past president, Mr. John Yule, this Association, recognizing the great advantage and element of justice that has been brought to the operating companies of Ontario by this legislation, feel it incumbent upon the Association as such to record in its minutes the hearty appreciation which it entertains for the original and continued work of Mr. Yule on behalf of such legislation, and that a copy of this resolution properly engrossed be prepared and sent to Mr. Yule, with the hearty compliments of this Association, at an early a date as possible.

On Mr. Yule's return the president put the motion, which, on a vote having been taken, was declared carried unanimously amid applause.

Mr. Yule: It gives me very great pleasure to hear your expressions so clearly set forth in your resolution. I give you my hearty thanks for keeping in mind the work that has been done by the Legislation Committee. You all know what has been done. Some three years ago we were attacked in Guelph by an attempt to pass a by-law to practically wipe us out. The by-law was defeated. I may say to my mind then it was the greatest injustice to an enterprise of a very problematical character. No one knew they would ever receive a return on the investment when they took the chance, and then as soon as the corporation came to think that you were receiving a dividend on your investment, they wanted to practically confiscate the property. I didn't go into this matter entirely for the sake of the companies in Ontario. I had principally in view my own company in Guelph, and there is no one more pleased than I am that we were as successful as we were, and I was very happy to support the Legislative Committee. The companies responded not only cordially and handsomely with funds, but they came down to Toronto when called on for assistance, and rendered very efficient aid. We have not only succeeded in getting the legislation, but we succeeded in convincing the members of the Legislative Committee that our position is right, and they were doing us no more than justice; during the last session they confirmed that position by giving us a further trial to work out the Conmee Bill. Three companies during the last two or three months have received the benefits of that bill to the extent of hundreds of thousands of dollars, and there are more to come. If I were to give a word of warning to the companies throughout the province, I would say they had better not be too aggressive in their dealings with corporations. Meet the corporations as soon as any advance is made, and fairly and squarely deal with them as they would deal with any other item of business. It appears to me this movement is going to grow; it will grow for a time, and then I think it will die out after they have had a little experience. I noticed an item in the Kingston paper referring to one place where they have had a municipal plant for a number of years with which they were going to make money and do wonders, and when they got in their last tax bill they found about three or four mills over and above paying for their light to help to pay for the electric plant and maintenance, and the way they did was they passed a by-law to raise funds to put in their plant, and they seemed to be under the impression that that was the end of the matter. They don't realize that the life of an electric plant is anywhere from six to twelve years; these debentures probably run for twenty years instead of ten years, and they had to pass another batch of debentures to rebuild and reconstruct, and possibly extend, and before the 20 years are up, if I am not mistaken in my judgment, they will have three lots of debentures going. Companies do not have that advantage, they have to pay as they go; they have to provide for depreciation, for extensions, and they have to provide to put in modern improvements as electrical machinery is developed. I thank you heartily for your kind recognition of my assistance to the electrical companies of Ontario.

Mr. J. J. Wright: In the meantime, while the meeting is waiting for the result of the ballot, I would like to move, seconded by Mr. Reesor, that it be resolved that the hearty appreciation and thanks of this Association be extended to the gentlemen who have prepared the papers presented at the meetings of this convention; and that the secretary forward a copy of this resolution to the parties indicated. Carried.

The President: I have to announce that Mr. Edward Slade is elected. Therefore the Executive Committee is as follows: Messrs. A. B. Smith, O. Higman, D. R. Street, J. J. Wright, B. F. Reesor, F. W. Simmons, W H. Browne, J.W. Camp, John Yule, and Edward Slade.

The President: As there seems to be no business before the chair, I want to take up your attention for a minute or two to tell you how extremely gratifying it has been to me to see such a large attendance at this particular convention. You are aware of what the circumstances were and how difficult it was, and how improbable it was, that the attendance would be large. At least, that was my impression; and it has been a very agreeable surprise to find that notwithstanding all these things, we have had a fair assembly and a successful convention. The papers have been good, and altogether I think that we cannot feel that we have lost so very much by postponing the convention to so late a date as we did. I came here with the determination to step out of office. I was exceedingly thankful for the confidence that had been reposed in me, and I was quite satisfied to put in the year, and then make room for someone else. It was only through the earnest solicitation, I may say, of friends that I consented to be re-elected. I rather think as a general rule, it is better for an Association of this kind to change its officers a little oftener than two years. To those who are entitled to the positions, and care to take them, it is rather a long time to wait two years between each election, and I don't approve of two year terms as a general rule; and that was one reason why I did not wish re-election, but so many things were said to make it desirable that I should accept this year that I finally consented to do so, and the convention being in Ottawa next year, was a special inducement. I will endeavor, during the year, to look after your interests and to organize a convention in Ottawa which shall be as successful as any which has been held heretofore. I trust I may receive the assistance of each and every-one of you if I should have to call on you. (Applause.)

Mr. W. H Browne: Brethren, there being no further business before this convention, and in view of the fact that the grand hospitality of this city has robbed a great many of us of our ordinary amount of repose, I rise to suggest and move a motion of adjournment of this convention until our meeting at Ottawa next year.

Mr. J. J. Wright: I second the motion.

On a vote having been taken the motion was declared carried, and the convention adjourned at 11.45 a.m., to meet in Ottawa in 1901.

## THE USE OF THE DYNAMO AND STORAGE BATTERY IN TELEGRAPH OFFICES.

By W. J. Camp, Superintendent C. P. R. Telegraphs.

Previous to 1870, acid batteries of various kinds were used for main telegraph circuits, and the Daniel form of blue-stone battery for the locals, or sounder circuits. Between 1870 and 1874, what is known as the "gravity battery" was brought into general use. This battery is a modification of the Daniel cell, but the sulphate of zinc and sulphate of copper solutions are kept separate by the difference in their specific gravity instead of by means of a porous cup. This form of battery is very constant and requires but little attention as compared with the acid. To obtain the best results not more than two or three wires should be worked from each bank, although frequently ten or more are thrown on one bank of battery. When this is the case the results are unsatisfactory, particularly during wet weather, and when wires of different lengths are combined together. A separate bank is required for each duplex or quadruplex set, and also a local battery for each sounder circuit. It is true that, as each cell gives out about one volt E.M.F., the exact power required for each multiple circuit or local can be very accurately adjusted by adding to, or taking off from the number of cells; and on this account, a great many chief operators raised objections to dynamo currents. However, even this advantage has been compensated for.

While the change from acid to gravity batteries effected a great economy in maintenance, and improvement in the working of the telegraph wires, a much greater stride has been made by the introduction of the dynamo and storage battery in telegraphic work. I will deal first with main lines, and then with local, or sounder and transmitter circuits.

About 1880 dynamos were introduced by the Western Union Telegraph Co. at New York for supplying current to the single working wires. The means for doing this are comparatively simple. Two dynamos are used, each of a voltage high enough for the longest wires; the positive pole of one and the negative pole of the other dynamo are earthed, and the opposite poles connected to two buss wires. The various single working wires are connected to these buss wires, according to the polarity required, through an artificial resistance for each wire. The Western Union in the United States, and both companies in Canada use incandescent electric lamps for these resistances. The Postal Co. in the United States uses German silver wire wound on tin tubes, so designed that, should any heating take place, it is counteracted by a current of cold air which passes through the tube. Additional resistances were inserted on the shorter wires to make all lines approximately of the same electrical length. These resistances were usually of fine German silver wire wound on the handle of a wedge which was inserted with the instrument wedge in the spring-jack of the switch. It has been found much more satisfactory, however, to have several dynamos giving different voltages, and the use of the resistance wedges abandoned.

The next step was to apply dynamo power to duplex wires. For many years back the polar duplex has been used all over America. When using the gravity battery the transmitter (pole changer) was arranged to reverse the poles of a bank of battery from earth to line and vice-versa. This pole-changer required very accurate adjustment in order to reduce the time of reversals to a minimum; the least break in the circuit, or short-circuiting of the battery, being liable to affect the signals at either or both terminals of the line.

For dynamo power the earth connection is omitted in the pole-changer; the armature is connected to the line circuit, the front contact to the negative buss wire, the back contact to the positive, and resistances of 600 or more ohms inserted ahead of each buss wire to prevent arcing at the contacts of the pole-changer.

Then came the application of the system to quadruplex circuits. Great difficulties had to be overcome to effect this. Two entirely different systems are in general use, one by the Western Union and Great North Western Telegraph companies and the other by the Postal Telegraph Co. The Canadian Pacific Co. uses the W. U. system at Toronto and Montreal and the Postal system at other points.

A few general remarks with reference to the duplex and quadruplex as worked with gravity batteries may be of interest at this point to those who have not read up the subject.

Duplex is a system by which two operators can transmit simultaneously in opposite directions. This is attained by winding the receiving relays with two coils of wire in opposite directions, one winding being connected to the line, and the other to a set of resistance coils and condensers which are so adjusted that the electrical length and static capacity are the same as the real line. The home power divides equally, half passing around the core in one direction to the real line, and half in the opposite direction to the artificial line; the result being that the core is not magnetized by it, and is not susceptible to any change in the home power. As the power coming over the line from the distant station only passes through one of the coils, and there is none coming in from the artificial line to counteract it, the core is affected by any change in power at the distant station. The receiver is a polarized relay whose armature closes the sounder when moved in one direction, and opens it when moved in the other. The transmitter is an instrument worked by an ordinary telegraph key and local circuit. It is so arranged that, when the key is depressed the negative pole is connected to the line, and positive when the key is opened.

Quadruplex is a system by which two operators can transmit one way simultaneously with two operators transmitting in the opposite direction, i. e., four messages can be sent simultaneously on one wire, two in each direction. The arrangement by which two operators transmit in the same direction may be briefly described thus:

A transmits by reversing the polarity to line the same as in duplex, and C receives by means of a polarized relay. B transmits by increasing and decreasing the same power which A is reversing; D receives from him by means of a neutral relay which responds to power of any direction if it is strong enough. The retractile spring of the armature is adjusted so that the weaker power does not move the armature, but when the full power is on the spring is overcome. By double winding both receivers at each end as explained for the duplex, we obtain "two circuits in the opposite direction."

In order to obtain satisfactory work all resistances must be maintained at their relative length. When using gravity battery transmitter "B" simply adds more cells to "A's" battery, or takes them off when closing or opening his key. A resistance coil to compensate for the internal resistance of the extra battery is automatically cut out, or inserted, thus maintaining the total electrical length of the line from earth to earth.

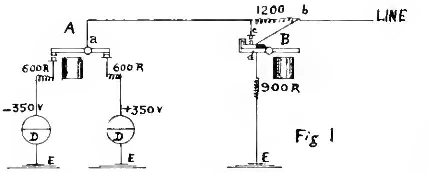



Fig 1

The W. U. system of transmission is shown in Fig. 1. The resistance from A to earth through the dynamo circuits is 600 ohms no matter which position transmitter A is in. When transmitter B is closed the resistance from b to earth is 600 ohms because the 1200 ohm coil is shunted out by contacts c and the leak of 900 ohms is disconnected at d. The full power of either the negative or positive dynamo goes to line through one of the internal resistances of 600 ohms. When the transmitter B is opened the 1200 ohm coil is inserted between b and c making the total resistance between b and earth via the dynamo of 1800 ohms. There is also another route to earth, through the leak of 900 ohms. The joint resistance of these two routes is 600 ohms, as found by the formula $\frac{A \times B}{A + B}$ or $\frac{(1200 + 600) \times 900}{(1200 + 600 + 900)} = 600$ thus maintaining the same resistance between b and earth for all changes.

The amount of power passing b to line is however reduced to 1/3 when transmitter B is open, first, on account of the added resistance of 1200 ohms, and second, on account of the leak of 900 ohms. In other words when transmitter B is closed the power passing to line is three times as much as when B is open.

By changing the added resistance to 1800 and the leak to 800 ohms the difference is then as 4 to 1 and the internal resistance still maintained at 600 ohms.

The principle of the Postal system of quadruplex transmission is shown in Fig. 2. For the purpose of explanation, transmitter A is shown as two separate instruments worked simultaneously

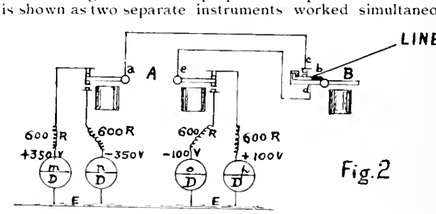



Fig. 2

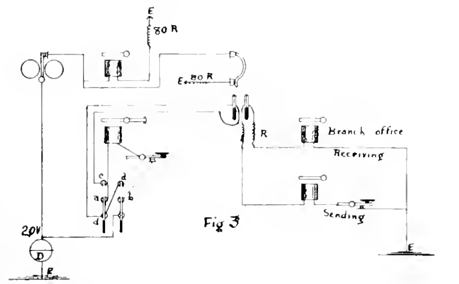
by one key. The one on the left gives 350 volts to the line and the one on the right 100 volts. Opening of the key connects either m or p to line according to the position of transmitter B; closing of key connects either n or o; or opening A gives positive pole and closing gives negative. Closing transmitter B connects line through b, c, a, to dynamos m or n (350 volts) according to the position of transmitter A; opening transmitter B connects line through b, d, e, with dynamos o or p (100 volts). Thus B transmits by increasing or decreasing the power sent out by A. As the resistances in each of the four leads to the dynamos are the same (600 to 1000 ohms) the internal resistance from b to earth is constant.

It is hardly within the scope of this paper to compare one system with the other. It is sufficient to state that either system has certain advantages and both give excellent results. The receiving instruments are the same as for gravity battery.

The dynamos are made of sufficient voltage for the longest quadruplex circuit from the office. When the same machines are used on comparatively short circuits a resistance coil of 1000, or more, ohms is inserted between b and the receivers.

We now come to the locals. For ordinary sounder circuits a very simple plan is to use a dynamo of 6 volts and connect all sounders in multiple. The sounders are wound to 20 ohms resistance; but in nearly every office where dynamos are used there are also quadruplex or duplex sets, and it is often necessary to connect these as repeaters. There are a number of systems, but I will only describe the one in use by the C. P. R. This is, I think, the most simple yet designed. It is shown in Fig. 3. Each half quadruplex or half repeater is treated as a

duplex set. All sounders and transmitters are wound to 20 ohms and, by resistance coils, each local circuit is brought up to 100 ohms. The dynamo gives from 20 to 25 volts. The former is found to be sufficient. The figure shows the instruments in a normal position, except that the transmitter wedge should be inserted in the spring jack. Starting from the dynamo the receiving circuit passes through the relay contacts, 20 ohm sounder, 80




ohm coil, earth to dynamo, the leg through jack being open at c. The sending circuit is from dynamo through switch b, key, 20 ohm transmitter, switch a, d, wedge, back contact of jack, 80 ohm coil, earth to dynamo.

To work as repeaters the wedges of the two sets are exchanged, that of No. 1 set, being inserted in No. 2 jack and No. 2 wedge in No. 1 jack ; the table switches a and b on each set are reversed.

The circuit then is, earth, dynamo, relay contacts, 20 ohm sounder, 80 ohm coil, earth ; also from relay contact to top of jack, front of wedge of No. 2 set, c, a, transmitter, key, b, d, back of wedge, coil and earth. The circuits from No. 2 set are the same. Any break in contacts of relay opens its sounder and also the transmitter of the other set. Thus signals received from the line on No. 1 set are automatically retransmitted over the line connected to No. 2 set, and vice versa.

To extend the locals of a duplex to a branch office, the loop wedge is inserted in the spring jack on top of the transmitter wedge ; switch a is turned up ; switch b down. Circuits are then as follows : Receiving side, dynamo, relay, sounder, coil, earth ; with leg from relay contacts to top of jack, front of wedge, coil, line, branch receiver and earth. The resistance coil is adjusted so as to make the circuit from wedge to branch earth total 100 ohms including branch sounder.

Sending side, dynamo, b, key, transmitter, a, c, front of transmitter wedge, back of loop wedge, coil, line, branch sounder, key and earth. The resistance from wedge to distant earth is 80 ohms including sounder. On this circuit the resistance of the transmitter is added making a total of 100 ohms.

Sometimes the dynamos are operated from a common shaft driven by an electric motor or other power, but the plan most generally adopted is to use motor generators, each machine working independently. In order to be reasonably certain of a continuous supply of power, spare leads are run to different power stations, and spare machines are also kept in readiness, so that not more than a minute or so is lost at any time.

In cities where continuous power cannot be obtained from at least two different stations, storage batteries are now largely used. Generally speaking, the wiring of a telegraph office, from the discharge leads of a storage battery to the instruments, etc., is the same as for dynamos, but extra switches have to be used for connecting the various banks of battery with the charging or discharging circuits. Various devices are used, but as I consider the C.P.R. system the most flexible, I will describe it only.

At Vancouver the Winnipeg street railway power is transformed by two motor generators ; one reducing the power to seven volts of twenty amperes capacity for charging local batteries ; and the other to 130 volts, 5 amperes, for main batteries. In Ottawa a 250 volt power is reduced to seven volts for the locals and the mains are charged direct without reduction. In St. John the 110 volt lighting circuit is used. The locals are in two banks, of two cells each, of chloride accumulator, type E 9, one bank being charged while the other is discharging. There is no dead resistance inserted in the local circuits, as is the case where dynamos are used, extra cells providing the necessary power when quadruplexes or duplexes are extended to branch offices.

The switch for the main batteries consists of a series of spring-jacks and wedges, so designed that the jack is open, and a wedge cannot be inserted when reversed. The cells (which are C3 type of accumulator) are arranged in banks of 40 or more as needed to meet the requirements of the office, and of a voltage sufficiently below the charging circuit. The negative pole is connected to the top of a wedge and positive to bottom. The wedges are all interchangeable. As many banks as required can be charged simultaneously.

In Canada, the C. P. R. has storage battery plants at Vancouver, Winnipeg, Ottawa and St. John, and dynamos at Toronto. The new Telegraph building in Montreal will also be equipped with dynamos. At present power in the latter place is obtained from the dynamo plant of the G. N. W. Tel. Co. I understand that the W. U. and G. N. W. Co's have storage plants at St. John, Quebec, London and Ottawa, and dynamos at Toronto and Montreal.

The adoption of either dynamos or storage battery for power on telegraph lines has very materially improved the working of the lines, and at the same time effects a great economy. One or the other will gradually replace gravity batteries for all main lines, and the time may come when even the locals at wayside stations will be worked by storage battery cells which will be charged at some central point and sent out by train.

## CONDITIONS AFFECTING THE WAVE FORM OF ALTERNATORS.

By L. A. Herdt and E. M. Archibald.

In what is given below it is not intended to consider the question of wave form as affecting successful distribution, but rather the extent to which the e.m.f. wave of certain machines may change under not unusual commercial conditions.

In alternator specification, along with regulation, heating and

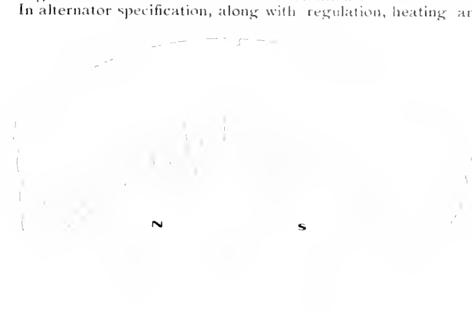



PLATE I

other clauses, it is often argued that a clause relating to wave form should be included, but as comparatively little is known of the extent to which the wave forms of modern alternators change with amount and character of load—to say nothing of the effect of such changes on the operation of the receiving machinery—it seems advisable that more information be accumulated before

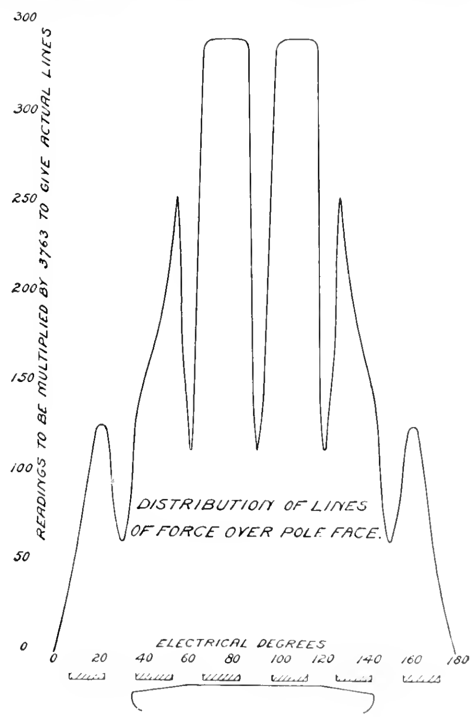



**PLATE I**

FIG. 2.

very rigid wave form requirements are inserted. However, with a view of throwing more light on the subject, a series of experiments were undertaken in the electrical engineering laboratories of McGill University during the past winter and though not complete, certain results already obtained may be of interest.

For the purpose in hand a number of different types of alternators were available, some with a concentrated armature winding, and some with distributed windings of the revolving arma-

ere, revolving field and inductor types. The e.m.f. waves were obtained from ... at different field excitations, different armature currents and different power factors, lagging and leading. The distribution of induction in the air gaps under different conditions was also obtained by means of small test coils suitably placed. As illustrating the general effect of lagging and leading armature currents in relation to type of machine upon induction distribution and consequent wave form, the results obtained upon a revolving field distributed winding alternator, part of the magnetic circuit of which is shown in Fig. 1, Plate 1, and upon


PLATE 2

an inductor type machine with a concentrated winding and poorly shaped inductor lug, shown in Plate II, may be cited.

In Fig. 2, Plate I, is seen the distribution of induction in the air gap of the first machine for the particular position of the field pole shown. As might have been expected, the larger part of the induction enters the armature through the teeth, but about one-third, in the case of those teeth immediately opposite the pole, passes into the armature by way of the slot due to the practical saturation of these teeth. The no load e.m.f. wave of each coil of the distributed winding may be constructed from the no load induction distribution curve by the method of tangents and for

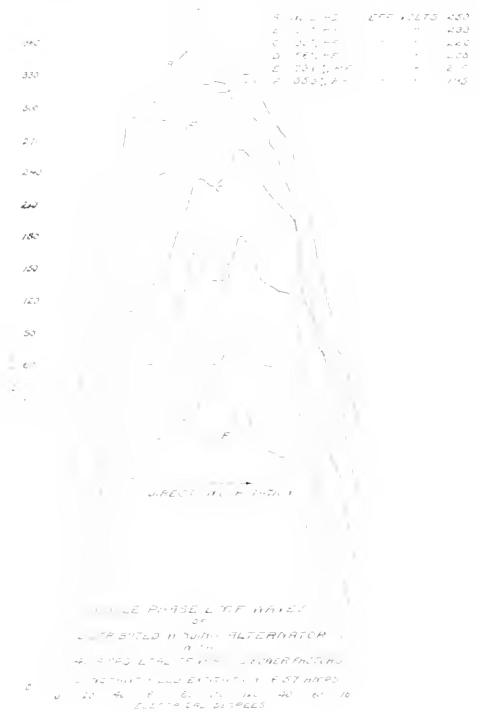


PLATE 3.

any group of coils by taking the algebraic sum of the instantaneous e.m.fs. of the individual coils. This has been done and the results found to check quite well with experimental values.

Plate 3 gives a series of e.m.f. waves for this machine connected as a single phase alternator at no load and full current load of different power factors, lagging current; the field excitation being kept constant.

Plate 4 shows the e.m.f. waves of the same machine connected as a quarter phase generator under similar conditions. It is to be noted that while the wave form and terminal volts both change a marked degree with power factor, the change is not nearly so great as in the case of the second machine having a concentrated winding and comparatively weak field.

With a concentrated winding the conditions are different, the

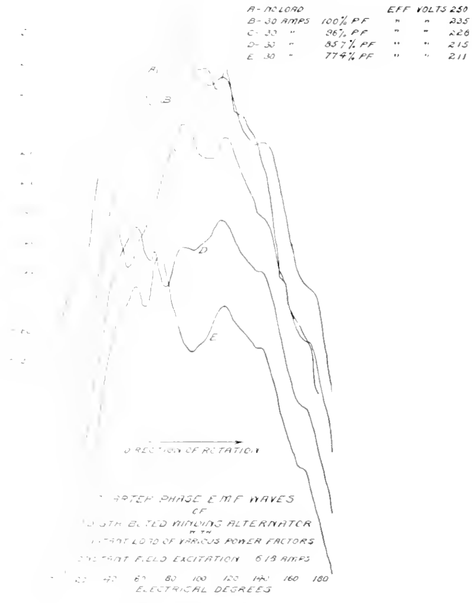



PLATE 4.

wave form not being a function of the angular displacement of the armature coils.

In Plate 5 is given the no load induction distribution in machine

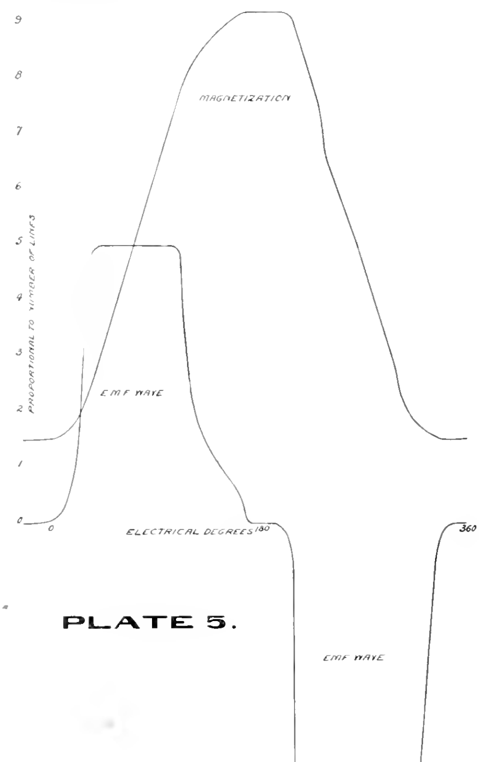



PLATE 5.

No. 2 at normal field excitation. It is to be noted that, due to poor design, the armature induction at minimum points is a considerable fraction of its minimum value, which would not be the

case in rightly proportioned machines of this type. With his machine also the no load wave form was readily predetermined from the curve of induction distribution and found to agree with the experimental values.

In Plate 6 is shown the no load and load E.M.F. waves at different power factors. The change of wave form with character

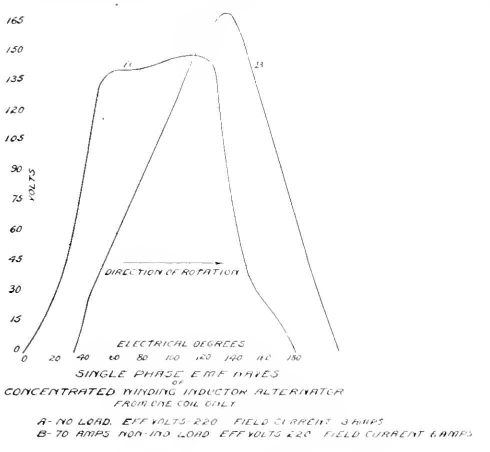



**PLATE 6.**

of load is, to say the least, startling, especially to those who have been accustomed to regard the sine wave assumption as to alternating E.M.F's. sufficiently near for practical purposes. The effect upon the operation of synchronous and induction machinery designed for sinusoidal E.M.Fs. of such waves as shown can be pretty well anticipated. Several synchronous motors were in turn operated from a generator whose wave form was made to

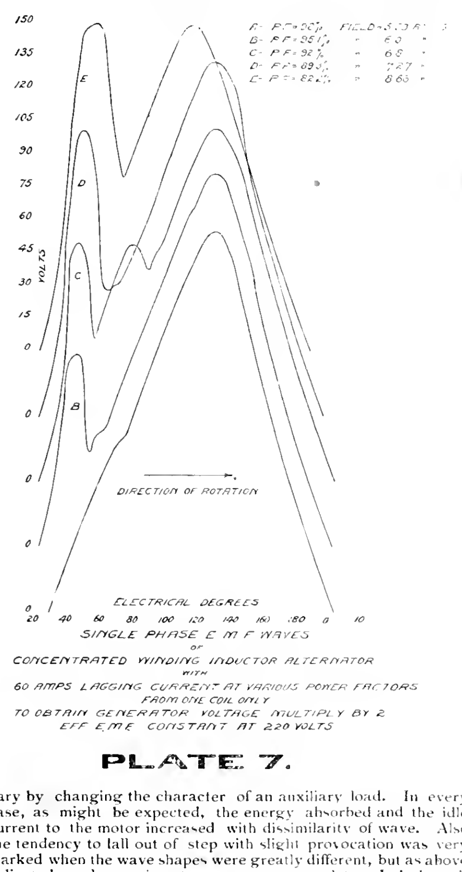



**PLATE 7.**

vary by changing the character of an auxiliary load. In every case, as might be expected, the energy absorbed and the idle current to the motor increased with dissimilarity of wave. Also the tendency to fall out of step with slight provocation was very marked when the wave shapes were greatly different, but as above indicated, such experiments are not yet complete. It is hoped, however, that enough has been said to induce a discussion of this certainly important subject, particularly from the standpoint of the purchaser and operator of alternating current apparatus.

We desire to acknowledge our indebtedness to Prof. R. B. Owens for the suggestion of the work carried out and for valuable assistance.

## POWER FACTOR AS AFFECTING OPERATION AND INVESTMENT, WITH SPECIAL REFERENCE TO INDUCTION MOTORS AND ENCLOSED ARC LAMPS.

By F. H. Leonard, Jr.

Power factor is the ratio of the true watts, to the apparent volt amperes in an alternating current conductor, circuit or device (Houston). In a direct current circuit the energy is calculated by multiplying the volts by the amperes, and the result is the true energy in the circuit in watts, but in alternating current circuits this does not follow, as the electromotive force wave is out of phase with the current wave in every case except when the load is purely non-inductive, as with a load consisting of incandescent lamps only. When arc lamps or induction motors are used, there is always a lagging phase displacement of the current, and when synchronous motors are used, there is also a phase displacement of the current which may be either leading or lagging behind the electromotive force wave, and both conditions may occur, in the case of the generator being driven by a steam engine, twice in each revolution.

With water power, a steam turbine or other prime mover where the angular velocity can be maintained practically uniform and where speed variations affecting the generator take place gradually in a period covering several revolutions of the generator, much better results can be obtained with synchronous motors, always of course presuming that the motor is designed to, and does in practice, give the same electromotive force wave as that produced in the generator, which for reasons which have been at length discussed by many able authors should be a sine curve.

Power factor is comparatively a new term to the central station manager, and in fact, was hardly ever heard of before the introduction of the A.C. motor, though some central station superintendents had noticed that there was considerable current flowing in their primary circuits when all their transformers were running with open secondary circuit, and that this current did not take the energy from the steam engines corresponding with the volt ampere readings. To express this condition the terms false currents or wattless currents were used.

The transformer when very lightly loaded or when running with open secondary takes much more apparent energy from the circuit than the real energy, because of the lag or phase displacemement of the current wave. This displacement, however, grows constantly less as the load is increased, until the E.M.F. and current waves nearly coincide. To illustrate this graphically, the two diagrams of E.M.F. and current waves in a transformer in open circuit and under full load show that the instantaneous values of the product of volts and amperes must be less than the apparent watts, and must be multiplied by the power factor to represent the true energy. As will be noted, the maximum E.M.F. occurs before the current has reached its maximum point.

Referring to the full load curve it will be seen that current and E.M.F. curves have nearly reached conditions where they increase and decrease together. The nearer this condition is approached, the nearer the power factor approaches unity or 100% power factor. As an induction motor is practically the same as a transformer with one of its elements in motion, its action with regard to power factor may be traced in the same manner, as explained in connection with a transformer.

The primary circuit furnishing the magnetizing current or field and also the work current by induction to the secondary, which when running light generates a counter E.M.F. so high that only enough current is taken in the secondary to overcome the friction of the bearings. As load is added the speed is slightly reduced, the slip resulting in lowering the counter E.M.F. until enough current is allowed to flow to do the added work. A very slight reduction in speed is sufficient to reduce the counter E.M.F. of the secondary of the motor varying not to exceed 5% in speed from light to full load and usually not over 2% over the working range of load usually met with.

These motors are self starting from the A.C. lines, and with suitable starting devices take about full load current for a few seconds in coming up to speed light, or a little more than full current in bringing up to speed their normal load, a somewhat longer time being occupied in reaching full speed, depending on the inertia and friction characteristics of the work.

If you will consider the counter E.M.F. of the motor secondary as the equivalent of resistance of the transformer secondary the similarity of action will be more striking.

The synchronous motor differs from the induction motor from the fact that it does not make its own field, which is usually excited from a separate source of direct current, and it is not usually capable of starting itself even without load, but must be brought up to synchronous speed by means outside of itself. A small induction motor is generally supplied for the purpose, which is disconnected after the synchronous motor has been brought up to speed.

The load is then applied gradually with a friction clutch coupling, friction pulley or equivalent device. Once in step, the synchronous motor cannot vary in speed, except the generator driving it changes speed, any more than though the two were positively coupled or mechanically geared together, except by overload much beyond the capacity of the motor, which breaks it out of step as though the gear were broken, and having fallen below speed even for a fraction of a second, it cannot recover, but will stall, in the meantime absorbing excessive current unless the circuit is immediately opened. The load must then be thrown off and the motor started again as at first.

The fact that the synchronous motor has a separately excited field is an advantage under certain conditions as pointed out in my paper before the National Electric Light Association at the New York meeting in '95. By increasing the field excitation sufficiently in a synchronous motor the apparent paradox of a counter E.M.F. higher than the line of impressed E.M.F. is produced by the motor sufficient to raise the E.M.

F. of the line, overcoming all drop, and even altering the pressure at the generator itself, at the same time introducing leading currents having a condenser effect on the line which may be made to balance out the lagging currents produced by induction motors, arc lamps, &c. If this leading phase displacement can be made equal to the lagging phase displacement of other devices, a power factor of unity would result, as suggested by an eminent engineer, though in practice, during a period covering the whole history of this branch of the art, I have never met such a condition, nor have any of my friends in the profession, many of whom have had extensive experience with synchronous and induction motors separately and both together on the same circuits.

An over-excited synchronous motor in the right place, with a load not subject to sudden variations and in charge of an attendant in communication with and controlled by the central station chief, is a convenient means of overcoming line drop and poor power factor. Over-excitation should not be carried too far, as it will result in pumping or flickering the lights. I have a vivid recollection of a case in which a 2½ h.p. self-starting synchronous motor, which I designed, pumped the whole circuit on a 300 k.w. alternator.

Under a steady load and careful adjustment of the field excitation, a large synchronous motor supplied with current from a well-designed generator driven by water power or steam turbine, a power factor at full load of .94 or a fraction better may be obtained, though the same motor furnished with current from the same generator driven by a slow speed reciprocating engine, would hardly attain a power factor of .90 at full load, as the fly wheel moment of the motor would make it difficult to follow the changes in angular velocity of the generator, the tendency to break out of step resulting in surges of current, as before intimated.

Generators directly connected to slow speed reciprocating engines, in my opinion, are not suited for operating synchronous motors or rotary converters unless extreme care is taken in designing the fly wheel so as to obtain the minimum change of angular velocity per revolution. A much larger percentage of speed variation taking place more gradually, is less disastrous to the attainment of high power factor.

The best load for a synchronous motor is one of uniformly steady character with no sudden changes in the work it has to do.

Throwing the load off suddenly calls for instantaneous adjustment of field excitation in order to prevent sudden rise of E. M. F. which in a large motor would affect the whole line, and even change the voltage of the generator, having a disastrous effect on incandescent lamps that may happen to be in circuit. Suddenly adding a load to a synchronous motor has the reverse result and adjustment of the fields become immediately imperative to prevent heavy drop in E. M. F. A single synchronous motor subject to sudden load variations may easily defeat any attempt at good regulation on the part of the central station management.

These objectionable features are minimized, though never wholly overcome by designing both generators and motor for exceptional regulation using a distributed armature winding with a large number of slots per pole, per phase. The old style armature with windings concentrated into a single slot per pole, per phase, are unsuited on account of their high armature reaction for this class of work.

The induction motor being complete in itself, requiring no exciter starting motor or clutches, and furthermore, being automatic in its regulation without any special appliances, free from commutators or brushes, is simplicity itself, its essential features consisting of a stationary primary and a rotating secondary in large sizes when well designed, has a power factor at full load of .94 or better, regulates well under sudden fluctuations of load without reflecting seriously on the line and generator, but in fact actually tending to assist the regulation of the line. A load thrown suddenly onto an induction motor immediately increases its power factor and helps the regulation of the generator supplying this sudden demand for current. As the power factor of the induction motor is low at light load, it follows that a sudden reduction of the load at once lowers the power factor of the motor, calling for lagging currents in the line, replacing by inductive drop the ohmic drop of the work current of the moment before the armature reactions in the generator tending to demagnetize its field and prevent increased E.M.F. which would otherwise result when load is thrown off.

For varying loads and for operating incandescent lamps in connection with a power circuit, under the ordinary commercial conditions, the preference is altogether in favor of a well designed induction motor. With a secondary consisting of copper bars secured to short circulating rings at both ends, insulation is never troublesome, and in fact may be omitted entirely. It rotates without electrical contacts or connections inside the stationary primary element which can be safely insulated for all ordinary voltages, and in the larger sizes connecting the two thousand volts pressure directly to the motor terminals. In the small sizes it is of course advisable to use transformers to reduce the pressure to 500 volts or less where subject to careless handling. Having once become familiar with them, you would never think of using direct current motors with their troublesome commutators and brushes and expensive repair accounts.

Intelligent selection of the size of an induction motor for the work it has to do, has a very important influence on the power factor of the line and should not run with an average load much below its rated capacity. It is much better to select the motor which, being loaded to its rated capacity, or nearly so, operates with a high power factor and can be overloaded for short intervals to the extent of 25% of its capacity without doing any harm, as there are no delicate parts to this type of machine, nor any moving insulated wires, they will stand a much higher temperature without deterioration than the equivalent direct current motor.

Induction motors are also designed for variable speed, many now being used for crane work, and other uses calling for variable speed and torque, but in this class of work they are hardly equal to the direct current series motor, and unless very expensively designed, operate with low efficiency and power factor, though where non-inductive resistance is used for control, the power factor may be improved at the expense of efficiency.

Arc lamps have been until recently operated from direct current series dynamos, though the first important arc lamp installation used in the city of London, England, the Joblacof candles as they were called, were operated by alternating current dynamos.

Several years ago the direct current incandescent companies realized the advantage of being able to supply arc lamps from their incandescent circuits and adopted the D. C. incandescent open arcs. These were soon followed by the enclosed arcs, which operating at a higher voltage admitted of individual control without excessive waste in the large resistance required with the open arcs. Besides this, a great saving was realized in the amount of carbon burned, the inner globes preventing access of oxygen which rapidly disintegrates and causes the carbons to waste away. By no means the least saving which followed was the reduced labor, one man easily trimming six times as many enclosed arcs as he could of the open arcs, as they required attention once in several days instead of daily trimming.

From the D. C. enclosed arc it was but a step to the A. C. enclosed arc with resistance in series, or with Auto-transformers or choke coils on commercial A. C. incandescent circuits.

It was found, however, that the A. C. arcs operated to reduce the power factor of lines with which they were connected, depending on the regulating device used in connection with them, it being practically impossible to obtain a satisfactory light without some regulating arrangement, though sometimes sufficient choking effect is produced by the feed regulating magnets. All such regulating arrangements reduce the power factor, except the resistance method, but the resistance while improving the power factor wastes true energy and reduces the efficiency, while the inductive regulators only increase the apparent energy or wattless currents.

The advantage of operating arc and incandescent lamps from the same dynamo simplifies the central station equipment and admits of the use of a single type of dynamo for all purposes of higher efficiency, interchangeable parts, one type of reserve apparatus, and easier switch board control.

Some of the best inventive talent on the continent has recently been employed upon devices to enable the central station management to rid themselves of the D. C. series arc dynamos, which at best occupy much floor space for their output and have a maximum efficiency of 75 to 80%, as against an efficiency of 90 to 97% in large modern A. C. dynamos which occupy the minimum floor space per unit of output at much lower first cost.

For A. C. street lighting with lamps in series, one device has followed another till we now have an almost bewildering variety, each device having its superior points, making the choice more difficult.

The constant current transformer operating a string of arcs is almost perfectly automatic provided the load is not too much reduced and can be tapped onto any part of the line to economize wire, the device itself being located in a small substation which may consist of an underground vault, as inspection and adjustment is not frequently necessary. This arrangement has a very fair power factor at full load, but the power factor is low when partly loaded.

A device operating on the choke oil principle l as all the advantages named in connection with the first arrangement. The amount of choking effect is regulated by the number of lights which is desired to compensate for. If a small percentage of regulation is required, a small regulator at low first cost is sufficient, and at full load the power factor is high, the inductive effect depending almost entirely upon the lamps themselves.

Another arrangement has been designed on the principle of the constant potential transformer with loops taken out to automatically vary the voltage as lamps are turned off or on. The power factor is good and rather better at light load than the others, but such a regulator should be kept in the central station, or in a substation when it has the advantage of an intelligent attendant.

Besides devices of the above types, individual transformers may be used, but their high first cost and the fact that each lamp must be turned on and off individually instead of in groups as with the previously mentioned apparatus, makes their use impractical for street lighting except under special circumstances.

In some notable cases where central stations are using power transmitted from a distance, induction or synchronous motors have been coupled direct to D. C. arc dynamos; this would be the ideal place to use a synchronous motor immediately under control of the central station if the induction motor load occurred at the same time, but unfortunately they occur at different periods and we can see no reason for using the synchronous motor, as the induction motor is self starting and requires no separate excitation.

In any case the motor driven arc dynamos are out of the question except where the frequency is too low for satisfactory arc lighting. Arc lamps are very unsatisfactory on 25 cycles and their effect at least unpleasant unless the frequency is in excess of 35 or 40 cycles.

With a mixed lighting and motor load there should be no difficulty in getting a line power factor of .90, and with load consisting mainly of motors .80 to. 85. I have in mind a case where about 3000 h. p. in motors ranging from fan motors to motors of 500 h. p. are used, and recently measurements showed a power factor of about .90, the percentage of incandescent lamps on the circuit being almost negligible.

A power factor of .80 at full load would be disastrous to the regulation of the old style single phase dynamos; no amount of excitation would enable them to hold the voltage on the line. Though many will no doubt recollect seeing at the World's Fair at Chicago in 1893, the then monster two phase dynamos, which were but two large alternators with armature mechanically coupled together so as to give the proper phase displacement to the two independent circuits.

Some of our Canadian water power stations who have not yet installed polyphase apparatus having two single phase alter-

nators, might adopt this method of obtaining two phase currents to start a power circuit. With ample water power, the added expense for a day circuit would not amount to much, probably little more than the cost of an additional attendant, which would easily be covered by a contract for furnishing power to some manufacturing establishment, or perhaps pumping water for the city and neighboring villages. The power business once started would grow rapidly and become an important source of revenue. Few realize the extent to which the power business is destined to grow.

The old style alternator will stand a moderate amount of motor load mixed with lighting load, but when the motor load becomes a large percentage of the total load, the old dynamos which perhaps were admirably adapted for supplying incandescent lights will no longer be suitable.

The growth of the motor business has called for radical changes in the design of alternators. Machines which on short circuit would give double full load current were the rule, and this was even urged as a distinct advantage in such an emergency. For motor work, the inherent regulation indicated by a short circuit current of at least three or four times full load current is demanded, and a change of excitation with full load current and .80 p. f. not exceeding 15 or 20%, and capacity for 25% more than normal full load current for six hours without dangerous heating, or 50% more than full load current for one hour, which means a very superior dynamo; this state of perfection having been reached through gradual evolutions resulting from the difficulty of maintaining regulation with motor loads and lagging currents, which tend to demagnetize the fields and lower the voltage.

The lagging currents call for increased capacity in the dynamo line and transformers which supply current to the phase displacing devices, though the power is not increased beyond the small amount necessary to supply the I. R. losses in the copper.

This calls for increased investment to cover the first cost of the improved dynamo transformer and added copper, though notwithstanding the advance in raw materials, the very superior dynamos of to-day cost no more than the dynamos of a few years ago, and not so much per k. w. as we were obliged to pay ten years ago for the old single phase dynamos.

In all classes of business it is poor policy to attempt to save on the first cost of a plant by buying machinery which is out of date. This is particularly the case in making an investment in electrical apparatus, the design of which has been undergoing such active gymnastics in the past ten years. We must look well into the future and anticipate the growth of the power business, which already bids fair to outstrip the lighting, and get only the best apparatus well up to date in every particular. The apparatus made by the leading electrical manufacturers on intelligent specifications more nearly approaches perfection than any other power translating device, notwithstanding the comparative youth of the art. What engine or water wheel builder would for a moment consider a specification calling for 96% efficiency? Yet electrical manufacturers for the larger sizes of dynamos will guarantee even better than such efficiencies.

With these high attainments it is hard to conceive of any material improvement in electrical apparatus, and we shall probably see little more of the changes once so frequent where entire plants were consigned to the scrap heap because it was cheaper to buy new than to continue even for a short time the operation of the old, the difference being sufficient to turn the balance between success or failure of the enterprise.

Already the process of standardization of things electrical has set in, and we may look for changes in the future, tending to a reduction to well recognized standards in construction of apparatus and central station practice rather than to startling improvements in design.

Power factor, which at one time was the great bug-a-boo of the electric central station, is now being rationally met and provided for in the equipment of power houses as a necessary evil and one of the incidental expenses of a new branch of the business, which adds materially to the income of the plant and enables the hard working manager and superintendent to please his stockholders with increased dividends.

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## SOME EXPERIMENTS WITH ROTARY CONVERTERS.

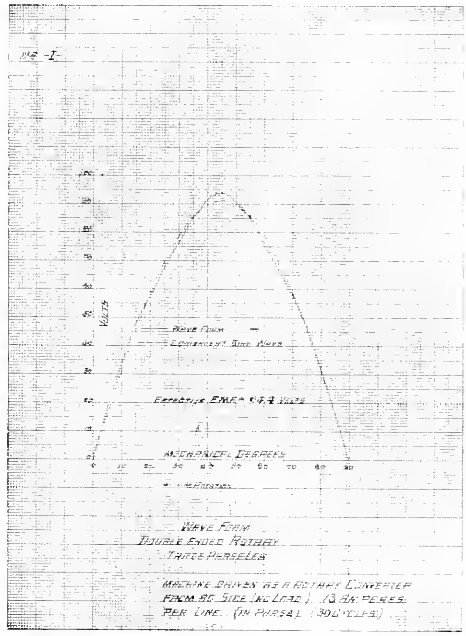
By A. G. Grier, B.Sc., and J. C. Hyde, B.Sc.

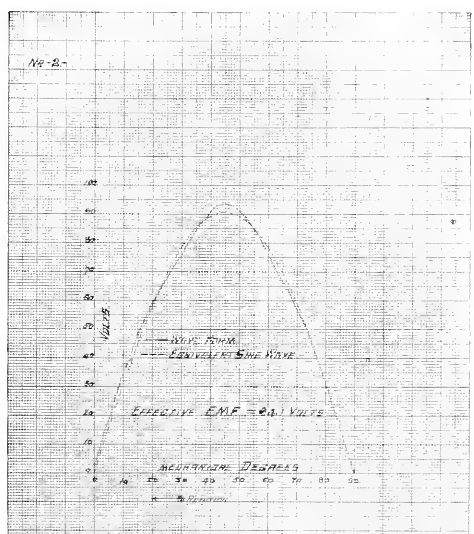
In the last few years Rotary Converters have gradually come to the front and at present are an important factor in some of the most modern and best equipped transforming stations. They form the connecting link between alternating and continous currents in the simplest and most efficient way.

The following experiments were carried out during the past session in the electrical engineering laboratories of McGill University.

### WAVE FORMS ON A ROTARY CONVERTER UNDER DIFFERENT CONDITIONS OF LOAD.

The wave forms shown as per curves were taken under different conditions on two rotaries. They show that armature reactions are very small and the 3 phase wave form approaches very near a sine wave, practically holding it under all conditions of load. The first four wave forms were taken on a double ended rotary, or in other words, one with two separate and exactly similar windings on the one armature body, each winding having its own commutator and collector rings. It was thus possible to run the machine as a rotary converter from one winding and get the induced volts from the other winding. The first curve is for an inphase running light current of 13 amperes, the second curve is for a 45 ampere lagging running light current, and the third a 45 ampere leading running light current and the fourth a 61 ampere inphase load current. From these curves the effect of armature reactions on the wave form is hardly noticeable. Curves Nos. 5, 6 and 7 were taken on the second machine, the greatest distortion of the wave being when the machine was mechanically run as a continuous current generator. In taking the wave



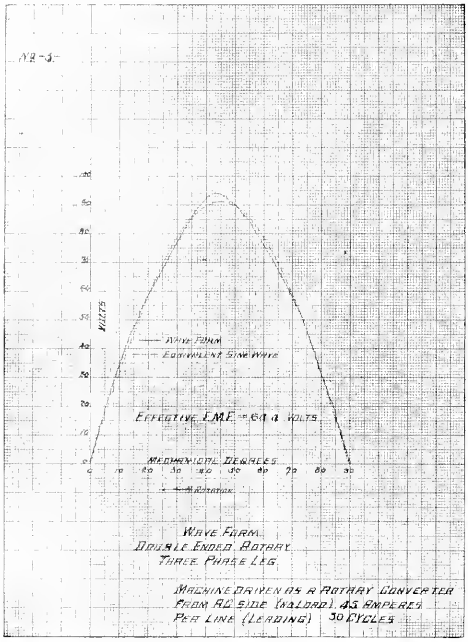



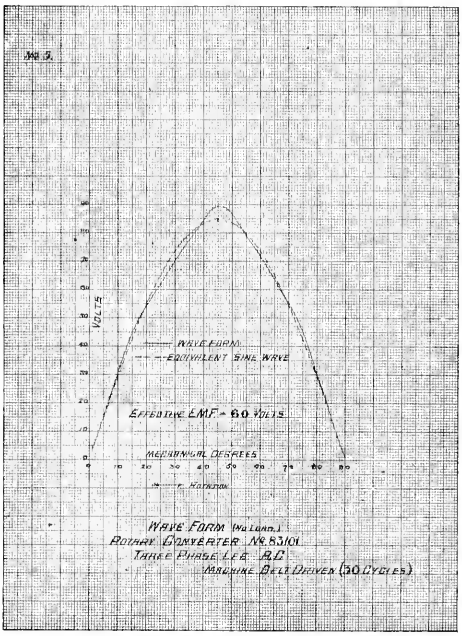

forms the voltage to be measured was made to charge a condenser which was then discharged through a Weston volt meter by means of a suitable disc placed on the end of the shaft.

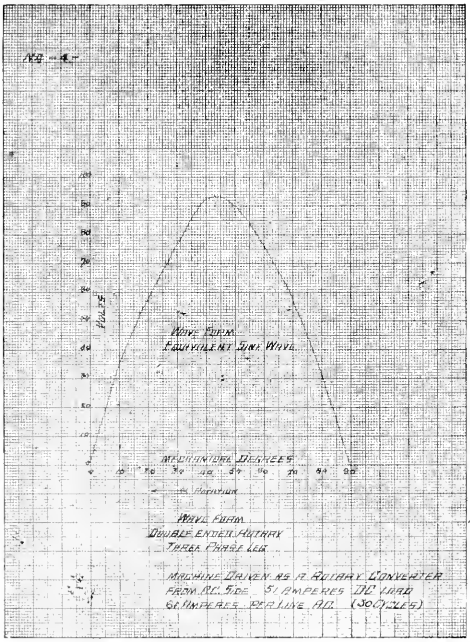
### COMPOUNDING A ROTARY CONVERTER BY MEANS OF IMPEDANCE COILS IN THE LINE.

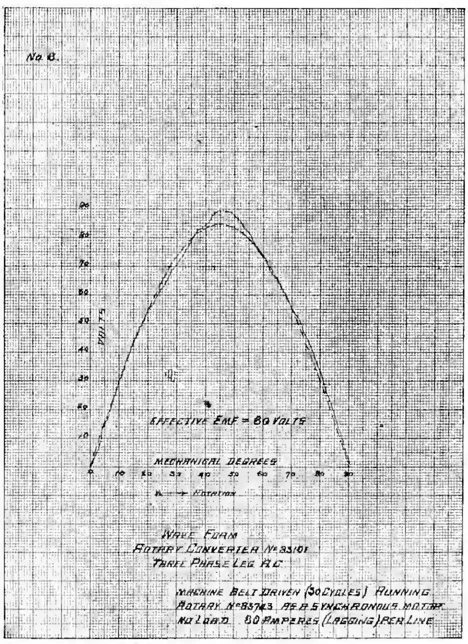
The D. C. voltage of a rotary converter depends on the impressed A. C. voltage, so that as the D. C. load comes on to keep up the D. C. volts some means must be used to raise the impressed A. C. volts. There are two general ways of accomplishing this, viz., by using induction regulators or having impedance coils in

the lines which, accompanied with a change in field strength of the rotary, will raise or lower the voltage as required. In some cases where a wide variation is required both ways are used. The action of the reactance coils may be made entirely self-regulating by having compound turns on the rotary. At no load a good lagging current should be used, gradually working up to an inphase current at about three-quarter load and a leading current beyond this. The diagram (No.8) shows an A. C. generator belt




driven feeding a rotary converter with compound turns. This machine when run as a D. C. generator was slightly over-compounded. The machines were used as three phasers. The D. C. regulation of the rotary converter at different loads was first taken without reactance coils in the lines, the impressed A. C. E. M. F. being kept constant throughout. After this three similar reactance coils were placed one in each line (machines delta connected) and the regulation again taken. In this case a lag of 68° was started with, ending up with a lag of 12°. The terminal voltage of the generator was kept constant at 85 throughout, the volts impressed on the rotary at start were 61.5 and rose to 70 at finish. Another way of seeing the effect of the compound turns on the power factor of the line, is to run the rotary no load (reactance coils in the line), separately excite the compound turns, noting the current in them and the circulating A. C. current between the machines. This was done and the results were plotted as per curve (No. 10 and 11). The D. C. regulations with and without the reactance coils in the line are also shown. (No. 9.)

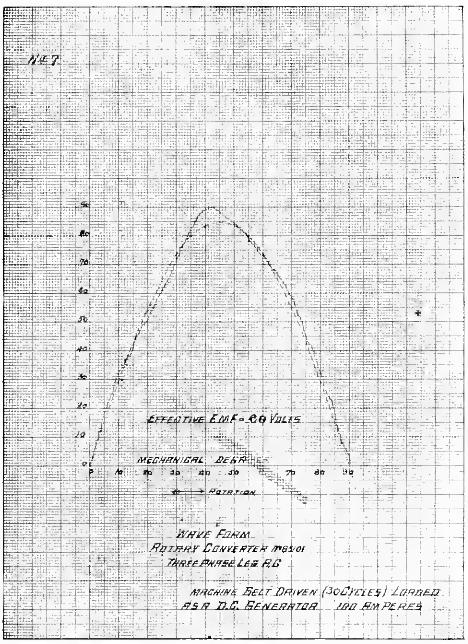
The frequency throughout was kept constant at 30 cycles. The following example is typical of the last experiment: Given a transmission line in which the receiver volts are to increase uniformly with load, 2880 volts at no load and 3160 volts at full load. The energy component of the current at full load being 52 amperes, at three-quarter load the current is to be inphase with

the E.M.F. at the receiver end. The line impedance is $Z = 8-30j$. What must be the (constant) generator voltage, the current in the line and the power factor at the receiver circuit?

Let $i$ = the energy component of the current
" $i_1$ = wattless " "
" $I$ = total current = $i + ji_1$
" $E_0$ = Gen voltage.
" $E$ = Receiver voltage.

Then $E_0 = E + IZ = E + (i + ji_1)(r - jx)$ or
$E_0 = E + ir + i_1x - j(ix - i_1r)$

From this formula everything may be calculated, since the gen-

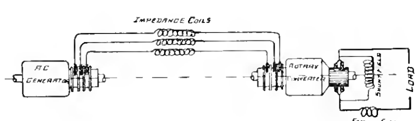



erator voltage (terminal) is to remain constant at all loads. The numerical results are as follows :—

Generator Voltage = 3597

| | No load | ¼ load | ½ load | ¾ load | Full load |
|---|---|---|---|---|---|
| Volts line ........... | 2880 | 2950 | 3020 | 3090 | 3160 |
| Energy current ....... | 0 | 13.00 | 26.00 | 39.00 | 52.00 |
| Wattless current ...... | 23.75 | 17.80 | 10.01 | 0 | —12.88 |
| Total current ........ | 23.75 | 22.05 | 27.92 | 39.00 | 53.60 |
| Power factor... .... | 0 | 59.0 | 93.2 | 100.0 | 97.0 |
| Lag of current ..... | 90. | 54.° | 21.° | 0.° | —14. |

Polyphase rotaries are self-starting from the A. C. side, and may be thrown direct on the line. They will pull two or three times full load current at the start, but will come up into complete synchronism, which may be indicated by a phase lamp or by the



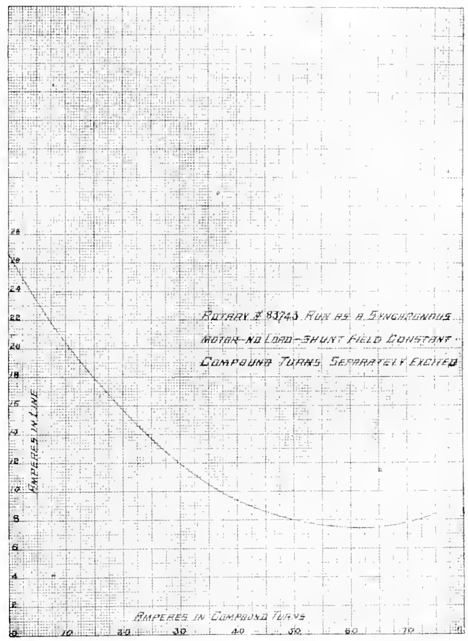

No. 8.

field switch. One of the rotaries used had solid pole tips, and came into synchronism when thrown on the line, but another rotary with laminated pole tips would not, and required to be brought up to speed (from the D.C. side) and thrown on the line by the aid of phase lamps.

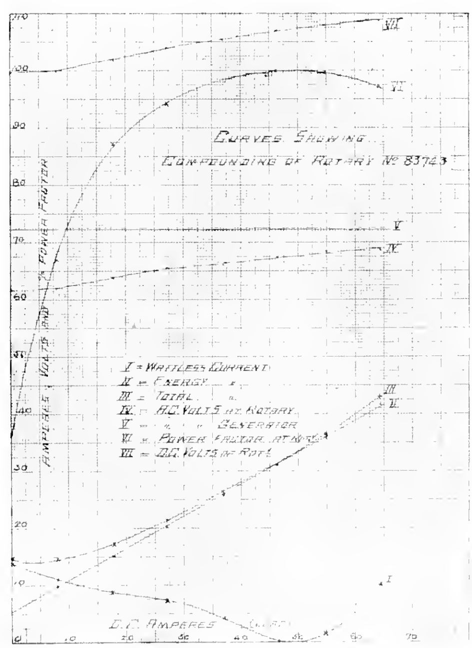
It was found that the first rotary would not come up into complete synchronism if the field switch was closed at the start, but would come up to about half speed and remain there. On opening the field switch, however, it would immediately run up.

As there are dangerous voltages induced in the fields (when left open) in starting in this manner, it is advisable to have the field circuit open in two or more places, as otherwise it would put too great a strain on the field insulation. The machines, when started up in this manner operate as hysteresis motors, hence the reason of leaving the field switch open. The D. C. polarity also depends on which pole the rotary synchronizes under, and therefore all D.C. meters should be out of circuit until the D. C. polarity is tested. Impedance coils may be used for starting in this manner so as not to affect the line voltage too much. Some means of cutting the fuses out of circuit at the start should also be provided.

Since single phase rotaries are not self-starting, and the alternating and continuous currents do not neutralize one another, it is more advisable to use synchronous motors and continuous current generators. It is now the general practice to magnetically




No. 10.




No. 11.

connect rotaries on their A.C. side when they are required to run in parallel from the same line. This allows of their being connected in series on their secondary side without causing the short circuit which would otherwise occur. It also does away with the circulating current, which otherwise occurs when they are connected in parallel on the primary and secondary sides, rendering the D. C. readings valueless.

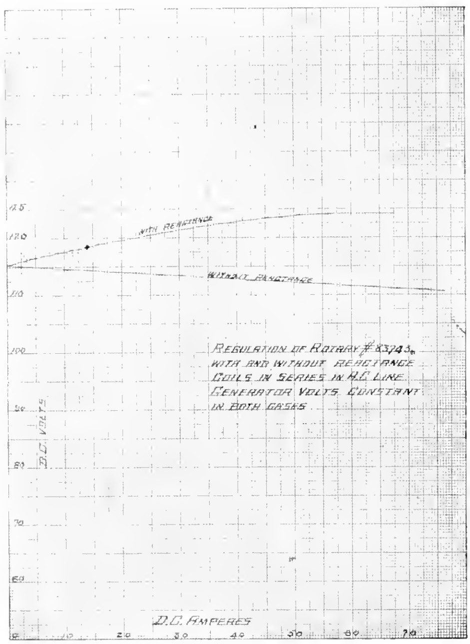
## ROTARIES IN STREET RAILWAY WORK.

In street railways it is very often necessary to cover very large districts. This means very large feeders to keep the drop of potential within limits. This requires a large outlay for copper and installing, neither is it very efficient.

The easiest way to overcome this is to have one main generating station and several sub-stations. In this station would be placed alternating current generators, and the power should be transmitted to the sub-stations, where there would be placed synchronous motors driving continuous current generators or rotary converters.

As rotaries allow of a simpler means of converting alternating current into continuous current, also being more efficient and allowing of better potential control, they are now nearly always installed for railway work.

On account of D.C. potential being directly proportional to the A.C. potential, it is necessary to have some means of controlling this in a long transmission line which has considerable resistance and self-induction. As railway load fluctuates a great deal, it




No. 9.

would be difficult to keep the potential constant at the terminals of the converter, especially as the current in the line may remain the same and still the conditions of load at the other end might vary a great deal. Take the case where current is leading or lagging; a watt meter in circuit might read the same watts, but in the first case the potential at generator should be lowered and in the latter should be increased. It is therefore necessary to be able to regulate the potential at converter. This can be done by changing field excitation of rotary; that is, changing phase relation of current and therefore increasing or decreasing the potential at the converter, as shown by the previous experiment.

Now, as a convertor is a synchronous motor on its A.C. side, we will have same E.M.F.'s acting as in a synchronous motor.

1st. The impressed E.M.F. at terminals.

2nd. The counter E.M.F. of converter.

3rd. The E.M.F. consumed by impedance.

The impressed E.M.F. depends on generator E.M.F. The counter E.M.F. is proportional to field excitation, and as its speed is constant, this counter E.M.F. is independent of load on the machine. The E.M.F. of impedance changes with load, and is proportional to load. The following diagrams (No. 12, 13 and 14) will show how generator voltage has to be varied to keep constant voltage at receiving end when phase relation of current is varied.

I.—When current is in phase with E.M.F.; that is, a non-inductive receiver circuit.

II. When current lags behind E.M.F.

III.—When current leads E.M.F.

I R = ohmic drop.
I X = reactive drop.
I Z = impedance drop.
O I = total current.
O E = voltage at machine.
O $E_0$ = generator voltage.

As these diagrams are drawn to scale, we can see how generator voltage varies with load to keep receiver voltage constant.

For accurate results the analytical method should be employed rather than the preceding method. The analytical method is as follows:

$e_0$ = generator voltage.
$e$ = receiver voltage.
$i$ = energy current.
$i_1$ = wattless current.
$I$ = total current = $(i + j\, i_1)$.
$Z$ = impedance of line and generator = $r - j\, x$

Now $e_0 = e + I\, Z$ (vector sum).

$$= e + (r - j\,x)\,(i + j\,i_1).$$
$$= e + i\,r + i_1\,x - j\,(ix - i_1 r)$$
$$= \sqrt{(e + i\,r + i_1\,x)^2 + (i\,x - i_1\,r)^2} - I$$

At non inductive load $i_1 = 0$.

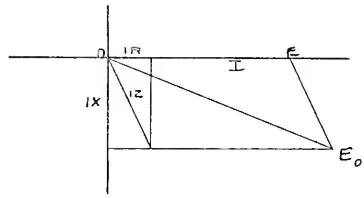
Then $e_0^2 = (e + i\,r)^2 + i^2\,x^2$ —— II.

At no load $i = 0$ very nearly compared with $i_1$.

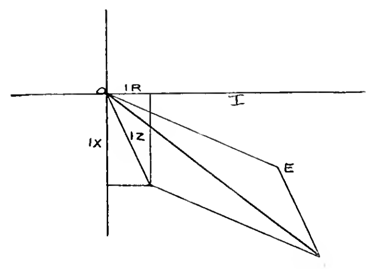
$$e_0^2 = (e + i_1\,x)^2 + i_1^2\,r^2 \text{ —— III.}$$

Now, as a converter can be made to take lagging or leading currents, the receiver E M F can be varied at will.

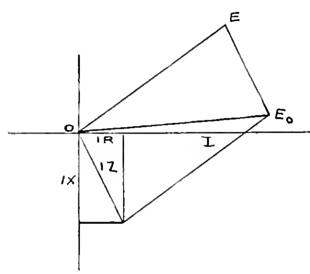
Having decided at what point you wish to run non-inductively,




No. 12.




No. 13.




No. 14.

it is necessary to calculate the running light current and to adjust the shunt and series field for same. From II and III the running light current may be obtained.

$$e_0^2 = (e + i\,r)^2 + i^2\,x^2 \text{ —— II}$$
$$e_0^2 = (e + i_1\,x)^2 + i_1^2 r^2 \text{ —— III.}$$

Therefore $(e + i\,r)^2 + i^2\,x^2 = (e + i_1\,x)^2 + i^2\,r^2$.

$$i_1 = -\frac{e\,x}{Z^2} + \sqrt{\frac{e^2\,x^2}{Z^4} + i^2 + \frac{2\,e\,i\,r}{Z^2}}$$

If $e = 1$ and if it is to be non-inductive at full load, let $I = 1$

$$i_1 = -\frac{x}{Z^2} + \sqrt{\frac{x^2}{Z^2} + 1 + \frac{2\,r}{Z^2}} \text{ —— V.}$$

If non-inductive at ¾ load

$$i_1 = -\frac{x}{Z^2} + \sqrt{\frac{x_2}{Z^4} + .56 + \frac{1.5r}{Z^2}} \text{ —— VI.}$$

From these equations we can get the running light current. The following would be the currents running light where converter would run non-inductively at full load $Z = .1 - .4j$.

| r | x | $Z^2$ | $i_1$ % of full load current. |
|---|---|---|---|
| .10 | .40 | .17 | .42 |
| .20 | .40 | .20 | .64 |
| .30 | .40 | .25 | .84 |

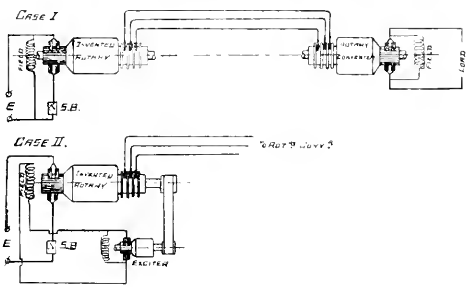
Converter to run non-inductively at ¾ load.

| r | x | $Z^2$ | $i_1$ % of full load current. |
|---|---|---|---|
| .10 | .40 | .17 | .31 |
| .20 | .40 | .20 | .45 |
| .30 | .40 | .25 | .63 |

From these results we see the effect of the energy loss on running light current. It is also evident the more the energy loss the higher should the generator voltage be relative to the converter voltage. It also shows that it is better to run the converters non-inductively at ¾ load, as before stated.

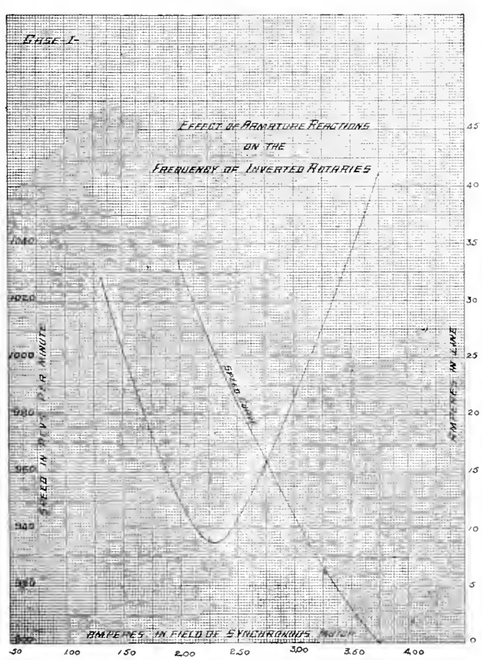
### INVERTED ROTARIES.

In some cases rotary converters are used to change continuous currents into alternating currents, or as inverted rotaries. Trouble arises immediately when the power factor of the line changes to any extent as it is accompanied by a change in the frequency of the machines. The reason of this is very readily seen. A continuous current shunt motor will speed up and down according as its field is weakened or strengthened, and for the




No. 15.

same variation in field strength at light loads its speed will change more than at full load. As an inverted rotary is nothing more or less than a D. C. motor running light, a very small change of field strength is accompanied by a large variation in speed. The effect of lagging and leading currents on an inverted rotary is to speed it up and down. One way of getting over this difficulty is to strengthen the field of the inverted rotary, as lagging currents come on or weaken it for leading currents. An ingenious and automatic way of meeting this difficulty was devised and put into practice by Mr. B.G. Lamme, which is as follows.



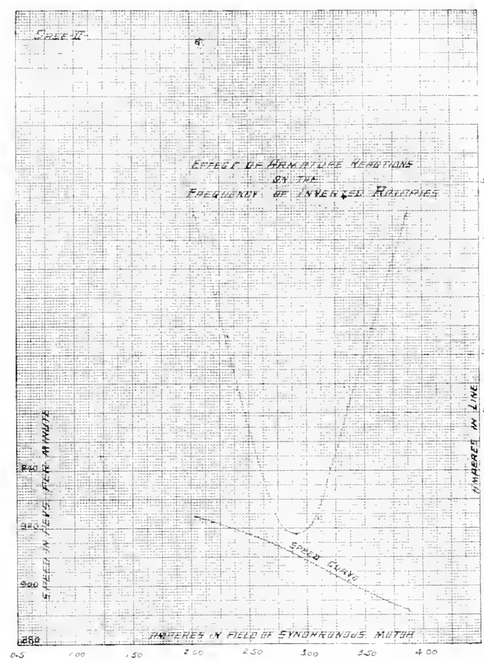

The inverted rotary is made to drive its own exciter which may be placed on the end of the shaft or belt driven from it. (No. 15.)

The exciter should be worked low on its magnetization curve so that a small variation of speed is accompanied by a large variation of voltage. Supposing that there was a lagging current on the lines the speed would rise, but the speed rising would strengthen the field, and if the one tendency were made to counteract the other a constant speed would be obtained. The following are the results of experiments carried out to show these effects. The exciter not being a specially designed one did not keep the speed absolutely constant out its effect is clearly seen.

In case I and II the voltage impressed on the armature of the inverted rotary was kept constant throughout and in case I the field current was also kept constant, thus any variation in speed would be due to armature reactions.

To get a large variation of power factor the field current of the rotary converter was varied and speeds as well as circulating currents were taken and plotted with field currents of the rotary converter as abscissae.

The effect of the exciter in case II is very readily seen, as for the same variation of field current in case No. I the speed changed from 900 to 1036 revs. per min. and in case II the change was from 892 to 920. If the inverted rotary were equipped with a compensating exciter similar to the one patented by




Mr. Rice, of the General Electric Co., then theoretically the frequency would be constant.

Another way which might be used is to automatically vary the field by having a Siemens epicyclic train, one wheel connected to the rotary, another to a constant speed motor, and the third connected to the field rheostat.

As regards to their practical operation inverted rotaries are now being used to advantage in transmitting continuous current power (from large D. C. power stations) long distances.

## CONDITION OF OPERATION OF STREET CARS IN THE CITY OF QUEBEC.

By D. E. Blair, B.Sc., Chief Electrician Q R L. & P. Co.

Of all financial undertakings, none perhaps depend more upon the nature of local conditions than does the successful development of a city street railway system, and for this reason it may be of interest to the members of this Association to have before them a more or less general discription of the difficulties encountered and overcome by those responsible for the development of the Quebec Street Railway.

Quebec, as a city, has many distinctive features that are not to be found in any other city in America, and the stranger within its fortified walls is very soon struck with the unique fashions, methods and temperament of the quiet people who make up what may be called the native population, numbering about 75,000, and of which about 65,000 are French-speaking.

When the construction of the road was first contemplated by those responsible for the promotion and fulfilment of the scheme, there existed certain unpromising conditions which tended to arouse the doubts of many as to the feasibility and possible financial success of the enterprise. Of these I might mention a few at random. Business, in general, is carried on in a very quiet and matter of fact way, and an observant critic does not notice the hustle and bustle so common in most modern cities of this continent.

The salary of the clerk and the wages of the laborer are moderate, and the average individual very seldom seems inclined to do any more than he is paid for.

The natural result of this state of affairs is that the electric street car was not likely to be looked upon as a valuable and indispensable time-rover, as well as a welcome convenience, but rather as a luxury to be enjoyed by those who could afford it.

The manufacturing interests of the city are limited, and further development along this line is hindered by the somewhat strict conservatism of capital. Further, the average laborer or even expert workman is the proud possessor of a large family, several

of whom are perhaps engaged in the same work as himself, and he finds it convenient and economical to live near his work, as rent in the manufacturing districts very reasonable.

The city is very compact and densely populated, being furthermore divided into certain sections which are practically self-contained municipalities. Public entertainments and social functions were very little appreciated or patronized, and the principal streets seemed almost deserted after 9 p.m.

Although these conditions may have no direct bearing on the practical expenses of construction and operation, they were certainly not in favor of the credit side of the prospective railway company's cash book.

The more formidable objections, however, were of a practical nature. Five years ago, and even less, it was considered impossible that anything that looked like a street car could ever climb the steep, narrow and winding thoroughfares that lead from the water's edge to the highest points of the solid mass of rock upon which the city is built. Besides this, the heavy snowfalls, coupled with the narrowness of the streets, were likely to be a great hinderance to the service, but in spite of everything the completion of the road was finally rushed through, and it has now been proved that the limiting conditions of the street railway operation were not overstepped in the bold undertaking which has given the people of Quebec a reliable and efficient means of transportation. The city has improved wonderfully since the inauguration of the road, and promises to become, before long, as wide-awake and progressive a centre as any in the country. Even theatrical entertainments have become more or less popular and everything seems to be moving at a faster pace than heretofore.

On the 1st November, 1896, was commenced the laying of the rails through the main streets of the city, and on the 1st July, 1897, the road was open to traffic.

Specifications of track were as follows:—72 lb. 6" steel T rails in 30 ft. lengths by Cammell & Sons, England. Standard gauge laying on 7" ties at 28".0 centres.

Each joint to be double rounded by two-00 solid copper wires in Eclipse copper bonding caps by Ohio Brass Co., these to be tinned and ends of wires riveted on outside of rail. Double cross bands to be placed at every 5th joint—150 feet.

OVERHEAD CONSTRUCTION.

Tubular poles 28 ft. long, weighing 700 lbs., and spaced 90 ft. apart, are used throughout. Insulation is of "Dirigo" type and trolley wire No. 00 hard-drawn. Span wires of standard galvanized steel wires 3/8" in diameter. Lightning arresters of Wurts' non-arcing type. All construction is elegant and of a substantial nature. Altogether there are 10 miles of span wire construction and 2½ miles bracket.

CAR SHEDS.—Of these there are two, one in Upper Town 210 x 120 ft., having 14 tracks and 7 doors, where all cars in service are laid up at night. The other is in Lower Town and is used for storage purposes only. The capacity of the working car shed is 52 cars, and here all repairs are done. There are seven floored pits communicating with the machine and blacksmith shops underneath. It has been found cheaper to manufacture most of the repair parts than to purchase them from supply dealers.

PAVING.—At this time all streets, without exception, were covered with a generous laying of macadam. Within the last two years, however, a great improvement has been made in this respect on nearly all the streets through which the lines run. All macadam was removed to a depth of about 12 inches, leaving the ties completely exposed, and these were then filled in with concrete to within about 4" of the top of the rail. The facing of the new pavement throughout the city now consists of Scoria blocks between and 8" beyond the rails, while the remaining strip of roadway is filled either with asphalt, asphalt brick or scoria blocks, according to the grade of the street.

In Upper Town, the residential district of the better class of people, the streets were nearly all wide enough to permit of a double track, but even here it was found necessary to run through certain sections on single track.

Lower Town, the business section of the city, is a semi-circular strip of varying width and of a practically level ground which is surrounded on the outer edge by water, and lying beneath the cliffs which mark the boundary of Upper Town. Here the lines are all single track with the exception of one section, where two parallel streets converge into one wide street ¼ mile in length. The main street which runs through the entire length of this section is about 2½ miles long and is so extremely narrow in places that there is hardly room for an ordinary vehicle to squeeze past on either side of a car, on the single track in the centre of the street.

The return line is run through a maze of narrow and unsymmetrical side streets which seem to run in almost any direction until they form a junction at an oblique angle with one of the largest arteries, thereby losing their identity.

On one section of the line, one mile in length, there are no less than eleven curves of from 35 to 40 feet radius at intersections of about 90 degrees, one of which requires a reverse curve of 40 feet radius.

On all these streets the inner rail is placed within two feet of one sidewalk in order to leave room for single vehicles to pass a car on the other side.

The Upper and Lower town lines are connected by two cross town lines which ascend obliquely along the face of the cliff. One of these, the Green Line, runs through the public thoroughfare which, though very steep, is yet feasible. The actual length of this line is 3440 feet, and the difference of level between injunctions is 172 feet, which is equivalent to an average grade of 5%. The total length is made up of sections of 200 ft. 12½ %, 100 ft. of 10%, and 600 ft. of 9.5% grades, the rest of the line being nearly level. All these grades have sharp curves in their lengths, but the most difficult to operate is the first. This one begins to rise at a gradient of 11½%, and terminates at 14.15%, these being a 40 ft. rad. curve at the top, of which one half is on the heaviest part of the grade.

The second cross-town line runs for a certain distance down Palace Hill at an average grade of 11% and then turns off the public street at an angle of 80° on to a steel trestle which runs parallel with the face of the cliff at a gradient of 7.5% for 800 ft. The total length of this line is 1300 ft., with average gradient of 6.85% and a maximum of 12%, difference of level being 89 ft. One disadvantage in the operation of this line is, that when a car leaves the trestle to take the 115% grade it is running at half speed and must be accelerated on grade. This means a very heavy drag on the motors for the first 50 ft. of the climb.

CAR SERVICE.—The Upper Town service consists of a double belt line, 3½ miles in circumference, with from 4 to 7 cars running in each direction on a 4 minute headway in summer and 5 minutes during the winter. Schedule speed on all lines is approximately 8 miles per hour, except for a few short stretches of level; the total length of this belt is layed on streets having a gradient of from 4% to 8%.

In Lower Town there is but a single belt line, both branckes of which are intersected by the cross-town lines. Cars running west are for most of their run within one block of those running east. Here also cars are run on a 4 minute headway and the service requires from 8 to 10 cars. Free transfers are issued from one belt to the other over the cross-town lines. These are run separately in winter, but two sides of a double rectangular belt line in summer. Both tracks are single and crossings are made at turnouts.

Strict regulations govern the operation of cars on grades and sharp curves. On some of the grades stop-boards are placed top and bottom and the motorman cannot proceed until signalled by the conductor. Speed down grade must not exceed 4 miles per hour. As a result of these precautions, runaway cars are very rare, and have never yet been attended by any serious consequences.

The average number of cars in regular service during the summer months is about 35, and in winter about 30.

BRAKES.—In every city of grades, such as Quebec, the system of braking should be of special interest, yet hand brakes are used throughout, the effective leverage being 100 to 1.

The brake shoes in use are of very soft cast iron, and it has been found that the retarding force due to the application of this shoe is much more evenly supplied and that the co-efficient of friction is higher under all conditions than it is when hard cast iron is used. This is especially the case in frosty or snowy weather.

New shoes weigh 19½ lbs. and wear down to 4½ lbs. Average life is 6150 miles, or 410 miles to the lb. of wear.

WHEELS.—All wheels used are of ordinary chilled cast iron 33" diam., weighing 425 lbs. each and mounted on 4" steel axle. Of these removed from cars during the first three years of operation there is not a great proportion of "flats," as will be noticed from the accompanying table.

| | | | | |
|---|---|---|---|---|
| | Wheels removed...... | 125 | pairs | |
| Of these | Worn out............ | 94 | " | 75.2% |
| | "Flats"............. | 23 | " | 18.4% |
| | Broken Flanges....... | 8 | " | 6.4% |

Average life, 24,800 car miles.
Maximum " 49,000 " " (reached by 10 pairs).

CAR EQUIPMENT.—The car equipment consists of: Thirty-five 28 feet double vestibule closed cars, weight fully equipped 14,500 lbs., seating capacity 30; 24 double and open cars, weight 16,500 lbs., seating capacity 50; 6 double ended snow sweepers; 2 double ended wing plows; 1 street sprinkler; 1 "converted" horse car.

ELECTRICAL EQUIPMENT.—The electrical equipment is standard throughout on all rolling stock and is of Westinghouse manufacture. It consists of 124 No. 12 A-30 horse power motors; 124 No. 28 A controllers; 62 sets controlling resistance.

All closed cars are fully equipped and in service during 12 months of the year, and the extra equipment required for sweepers and snow plows during the winter are borrowed from the open cars.

The sweeper and plow equipments are necessarily very much overloaded at times, and it will be of interest to some here present to know how they have stood the hard usage.

OVERLOADS ON MOTORS.—An overload of 100% for several minutes at a time has often been carried by these during heavy snow storms, and a sweeper will sometimes burn five or six No. 13 B & S copper wire fuses, or in other words draw from 200 to 250 amp. at 520 volts before it can get past a difficult spot. This extremely hard usage does not seem to have any very bad effects beyond a temporary softening of the armature insulation and sometimes the loss of a certain amount of solder from the commutator connections, and the management are proud to say that they have not had a single armature burned out since the road has been in operation, in fact the only trouble they have ever had with an armature is that in two cases the insulation was scraped off the wires by rubbing against the pole pieces in consequence of a defective bearing. This is not a bad record considering that there were 124 of them in use. There has never yet been a commutator lost, or even has it been necessary to repair one, apart from resoldering a few melted connections, and the heaviest wear on any diameter up to date is ⅜ inches, and the average wear taken from the first 28 closed cars in operation is 22 inches on the diameter after having made an average run of 71,800 miles. There has not been a commutator "flashed" or "bucked" in the past 18 months, and this perhaps is largely due to the excellent

quality of brush used, as well as to the constant care that they receive.

CARE OF MOTORS.—It has always been the practice to send an armature to the lathe at the first sign of a "buck," and it has been found that this is absolutely the only way to prevent a re-occurrence of the trouble.

A sharp eye is kept on the brushes to see that they do not wear down too far or become gripped in their holders, and commutators are cleaned and sandpapered about once a week with No. 0 sandpaper, although it is quite common for a commutator to keep a nice chocolate glaze for over a month without being touched.

The commutator is the most delicate and troublesome part of any electric equipment, and there are two or three more points which ought to be strongly recommended in its care:

1st—To send it to the lathe before it has worn down too far. Just as soon as a slight shoulder is formed at each side of the wearing surface, the brush is lifted by the end play of the armature and unnecessary and expensive sparking is the result. Further, the copper segments are rarely of a uniform boldness throughout, and the least inequality of wear soon develops into a low spot on the commutator.

2nd—It is very important that the brush springs be set at the proper tension, and it is easy to make a rough comparative test of this statement with no other tools than a pair of calipers or steel tape line and an angler's spring balance. It will be found that too light is just as serious a defect as too heavy a tension, if not more so. In one case excessive wear is due to sparking and probable "flashing," and in the other to actual friction.

3rd—See that brush-holders are accurately aligned so as to divide the current equally between the two circuits of the armature. If the brushes are but the thickness of one segment out of place, one is liable to be notified of the fact at the first heavy overload on the motor. Of course a great deal depends upon the quality of brush used, and cost price of this article should not be considered.

The brush used here averages a life of 12,600 car miles and costs 15c. a piece, which is more than most brushes of this size on the market, but let any one just make a simple calculation to see how many times the difference in the price of the brush goes into the saving effect by prolonging the life of a commutator several years.

The cost of renewing one commutator would keep a 50 car equipment in brushes for two years.

(I have now to apoligize for having perhaps tired you with detail, but I feel that a great deal more could be said on this subject if time and courtesy permitted.)

Some trouble has been experienced during the snow storms of winter by the grounding of field coils, but means have been found to effectually prevent this in future. I might here mention that during 12 hours of a cold dry snow storm, when light particles of snow are flying about, 2 or 3 gallons of water are sometimes collected in the bottom of the motor casings. Water and slush in the spring time have given no trouble.

A word about controllers. Aside from the burning out of a couple of magnetic blow-out coils, there have never been any repairs made on any of the 124 controllers in service beyond the renewing of the sparking tips of the drum, which is done about once in two years at cost of about 50c. a controller.

Here again are the results attained by vigorous inspection and careful cleaning each night.

Apart from the nightly inspection it is the practice of the road to thoroughly overhaul every car once in every six weeks. This work is done in day time. Bearings and armatures are examined, brush springs set, brake rigging adjusted, and journal boxes examined and renewed if necessary.

As a result of this routine work, which costs but little, it is seldom that the service has to suffer the annoyance and blockade of traffic caused by a disabled car on the road. It can be safely said that there are not more than 2 or 3 cars ever pulled out of service for any reason whatever from early spring to late in the fall. In winter the number is somewhat greater.

CURRENT CONSUMPTION OF CARS ON GRADES.

The current required to get a loaded car up the steepest grades on a good summer rail, is practically constant and well within the overload capacity of the car motors. The maximum amount usually drawn from the line at 520 to 540 volts under such conditions is rarely above 125 amperes, and that for a short time only. The average current is from 60 to 80 amperes per car.

Just as soon as the appearance of snow or ice on the rail has to be considered, the ascent becomes a more serious question. Wheels begin to skid and the car loses momentum, then sand is applied, and the sudden overload on the motors as the wheels take a grip is often beyond the capacity of the heaviest fuse wire it is safe to use on the car equipments, viz., 14 B & S. This wire will carry 180 amperes for several minutes in winter time and 200 amp. for about 10 seconds, and this will give a rough idea of the power required. The rated capacity of the motors is 50 amp., so that when running on the parallel connection the rated load per car would be 100 amp. In other words, every equipment on the road has frequently to stand each day an overload of from 50 to 120 per cent. These figures, however, are yet too low for the current consumed at times by the driving motors on the sweepers. On these there has been frequently measured an overload lasting an appreciable time of 180% to 200%. Apart from these sudden maxima, the average load distributed between the two motors sometimes averages 150 amp. for hours at a time, including several short periods of comparative rest. Some, I know, will say that it is extremely bad practice to strain an equipment to such an extent but, without denying the charge, it may be said that these sweepers have cleaned over 6,000 miles of track every year for the last three years, and the only mishap which occurred to any one of them during the third year of their operation was the grounding of one field coil, this too in spite of the fact that they were on one occasion running for 106 hours continuously, each one wearing out 3 or 4 sets of brooms during that time. On several occasions they were running continuously for two or three days, except for an occasional stop of an hour to renew the brooms.

Curve No. 2 shows the average power required by each car in service during each month of the year. These curves are calculated from the readings of an integrating wattmeter in the central station.

The total cost of maintenance of electric equipment per car mile per year is 17c.

EFFICIENCY OF MOTORMEN.—The car service calls for a working staff of 70 conductors and as many motormen. All motormen before being accepted on the road must go through a period of training averaging from three weeks to a month. Part of this time is spent on the road in the company of a good regular motorman, and at least a week is spent in the car sheds, where the novice acts as helper at nominal wages. He is then examined as to his knowledge of the road, car equipment and regulations. Very little technical knowledge is required beyond a thorough understanding of the different parts of the equipment. As a result of this discrimination against the blockhead and the fool, it is a marked fact that on every car in service, "the man behind the gun" knows his business and uses his brains to the advantage of the company.

SNOW AND ICE.—The greatest difficulty encountered by the Railway Company in its efforts to provide a regular and efficient car service during the winter months, is the clearing away of the snow from the tracks. It is not so much that the snowfall is somewhat heavier than in Montreal and Ottawa districts, as that the extremely narrow strips of roadway either one side of the track or the other, soon become piled up with snow to such an extent that all snow removed by a passing sweeper immediately slides back on to the rails and blocks the passage of the following car.

Another serious disadvantage is that all cars in the city have to run over some sections of single track. This fact requires, of course, that cars shall make regular crossings at certain points, and if one car should be late for—or worse still, not reach its crossing point, several of the following pairs of cars which cross at the same point will be stalled there until the tangle is straightened out. A delay of this sort is disastrous in many ways, because the leading car, when it gets away, has sometimes to plough its way through a heavy accumulation of snow until it is, possibly, extricated from its sorry plight by a passing sweeper, which has to be signalled and shunted past the waiting cars before it can be of any service. Matters are soon straightened out, but then that sweeper should have been somewhere else and there is more trouble ahead. Just as long as all cars make their proper crossings, no matter if they be a few minutes behind scheduled time, everything works smoothly, and after that, complications seem to increase in geometrical progression.

It is the practice to send out the "wing plows" as soon as a certain amount of snow has fallen, and these follow the sweepers around the whole length of the track, at regular intervals, pushing the snow piles back as far as six feet from the rail where it is possible, although there are miles of track to be kept open where there is less than that distance between the rail and the actual buildings, to say nothing of the sundry poles and sidewalks that necessarily intervene.

As the day wears on and the snow still continues to fall, the swing of the plows is limited to two feet and possibly to one foot, after which it is a hard struggle to keep everything moving through the rectangular channel four to five feet deep which has been formed by the wing plows in their endeavors to clear the right of way.

There are several bad spots at which it is absolutely necessary to keep gangs of snow shovellers at work as soon as the storm reaches any more than even moderate proportions.

It has further been necessary on two or three occasions to pull all cars out of service in order to give the tireless sweepers a chance to keep the road open, but only once in 1898 and once in 1899 has the service been entirely blocked, and that for one day only.

Nearly all cars in service now carry side brooms or flangers about three feet in length, which are set obliquely across the rails about one foot ahead of the front wheels. These consist of cast frame, into which are fastened a number of cuttings from the sweeper brooms about ten inches in length. They cost very little and have proved of invaluable service in keeping the rails clear of snow during the hourly or half-hourly intervals between passing sweepers; in fact, the car service very often depends entirely upon these to get through a light snowstorm, a couple of sweepers being sent out, after it is all over, in order to clean up.

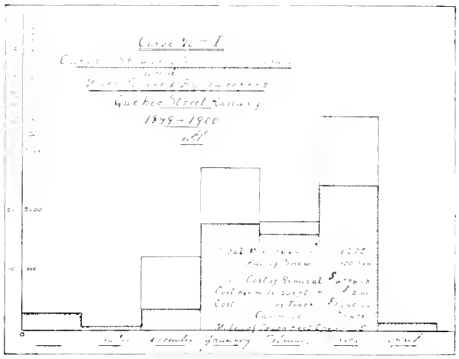
These long brooms have another great advantage over a narrow steel wire brush in that they keep the snow and ice at each side of the rails at an easy slope toward the bottom, instead of cutting a deep rectangular trough which remains filled with snow after the sweeper brooms have gone over the track.

Since adopting these brooms on the road, a marked decrease in the power consumed by the rolling stock during storms is noticed, and a great saving has been affected in the quantity of rattan used by the sweepers for each mile of sweeping. This results from the fact that when the transverse section of the winter road-bed is properly graded the sweeper brooms need not be let down so far in order to clear all snow from the rail, thus saving a great deal of breakage.

The average snowfall in Quebec for the last three years has

been as follows: 1897-98, 104.6 inches; 1898-99, 120.6 ioches; 1899-00, 100.3 inches.

Curve No. 1 shows the proportion of last year's total fall during each month, also the number of miles covered by the sweepers during each month of the same year. Further data relative to cost of removal will be found beneath. These include all cost of




sweeping, shovelling and carting away of snow, as well as the interest, depreciation and maintenence of the necessary equipment.

With reference to the removal of snow, the city by-laws enact "that proprietors or occupants shall remove the snow and ice from their roofs and from the streets, from the street line to the centre of the street, and keep the same within two inches of the pavement."

The by-law granting a franchise to the Quebec Railway, Light & Power Co. enacts "that the company shall remove the snow from their tracks and two feet on either side thereof." As the Company could not see their way to carry out this regulation without having trouble with the proprietors or tenants, they every year make an arrangement with the tenants on that side of the street on which the Company throw their snow, to remove the same, paying them at the rate of 10 cents per lineal foot of their frontage, except in places where the snow is known to accumulate, where they pay at the rate of 15 cents per lineal foot. Consequently, all the Company have to do is to throw the snow off their tracks, leaving the proprietors to remove the same along with their own. With this arrangement the proprietors seem very well satisfied.

One can better appreciate the relative magnitude of the snow expenses when told that $1.54 has to be deducted from the daily gross earnings of every car in service during the year in order to make up the amount.

HEATERS.—All closed cars in service are heated electrically during six months of the year, the heaters being divided into 4 sections, two on each side of car, each pair being separately controlled. The current consumed by each pair is 4.9 amp., and it therefore requires 9.8 amp. at 520 volts, 5.1 k.w., to heat a car during four months of the year when both sides are in use, but during the months of November and April one side is quite sufficient to maintain a comfortable temperature within the thin shell which composes the car body.

Taking the average time of service of car at 18 hours per day, and the actual cost of the extra current required at 65c. per k.w. hr., the cost of heating one car is as follows:—

5.1 x .65 = 3.21 cts. per hour
58 " " day
150 x 58 = $87.00 " " year.

This is equivalent to .204 cents per car mile, and the maxim taught is, "don't use electric heaters in a cold climate unless you have the advantages of an unlimited water-power and station capacity." The interest on first cost, depreciation and maintenance of the heating equipment would not add more than 2 or 3% to the figures.

The electric railway, as well as nearly all lights and motors in Quebec, are operated through a sub-station within the city, from a power house situated at the Falls of Montmorency. The power house is 150 ft. long and 50 ft. wide, and contains the following equipment; 3-600 k.w. 2 phase 66 cye 5,500 volt S.K.C. alternators; 1-750 k.w. 2 phase 66 cye 5,500 volt S K.C. alternators; 1-600 k.w. double current 273-500 volt Westinghouse generator; 2-30 k.w. bipolar exciters.

All the larger machines are direct connected to 52 in. water wheels of 1000 h p. capacity each, and operating at a speed of 286 revolutions per minute. They were built by the Stillwell Bierce and Smith Vaile Co., of Dayton, Ohio.

The power is transmitted to the city over 16 wires, carried on two separate pole lines. Each machine is fed into a separate circuit at Montmorency, but may be connected in parallel at the sub-station in the city. the sub-station consists of a substantial stone building containing the following machines: 2-600 k.w. 2 phase S.K.C. synchronous motors, taking current at 5000 volts direct connected to 2 500 k.w. 550 volt G. E. railway generators, 2-200 k.w. 2 phase 5000 volt synchronous motors direct connected to 4 125 light multi-circuit Brush arc machines.

Besides these are the direct connected starting motors required for the motor-generators, 2 exciters driven by induction motors, and all necessary transformers and switchboards for distributing the current to its various uses.

RAILWAY SWITCHBOARDS.—The railway switchboard contains—besides switches, circuit-breakers, volt and ampere meters and field resistance—1 Thomson intergrating watt-meter, 2 Bristol recording an.meters, and 1 Bristol recording volt-meter.

From the daily readings of the first has been prepared curve No. 2, which shows the current consumed by the railway cars during each month of the year. It will be noticed how much more power is required during the winter than in summer, in pite of the fact that fewer cars are in service, and the car miles run by each are fewer than in summer. It will also be seen that, during the month of February, each car consumes an average of 24 h.p. during a whole day's run.

The maximum overload capacity which the station is ever called upon to furnish the railway, is about 900 k.w., and a yearly average is about 350 k.w.

The peak of the summer load very rarely reaches 550 k.w. and is easily handled by one generator, although a 10 or 15% increase over this load would be very liable to pull the synchronous driving motor out of steep, if of long duration.

Time has unfortunately not permitted the preparation of any accurate curves to tell the story of the station's output, but one may form an idea of the average fluctuations by an examination of the recording ammeter charts on exhibition.

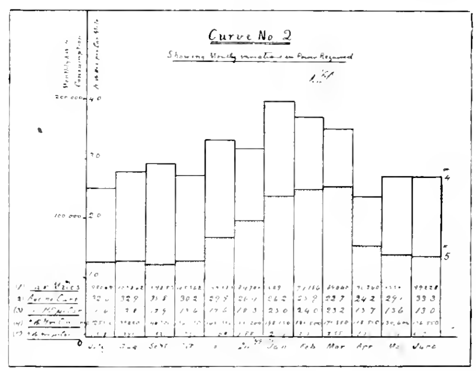
Before closing this very hurriedly prepared paper, it may perhaps be in order to make a few remarks relative to the conversion of the old Q. M. & C. Railway to an electric suburban line. This excellent road-bed now serves to carry a fast service of electric cars, interspersed with steam trains, which handle the heavy traffic between Quebec and the Shrine of St. Anne de Beaupre.

A trolley wire is suspended at a height of 22 ft. above the rail by stranded steel span wires hung from wooden poles, and the rails have been connected with single bonds of No. 00 wire for a distance of 26 miles. A copper cable of 300,000 C.M. area runs parallel with trolley wire for most of its length and is connected to the trolley every quarter mile.

This cable is fed at a pressure of 560 volts at 3 points, at Quebec, at Montmorency, 7 miles away, and at St. Annes, 21 miles away from the city, all power of course being generated at Montmorency and transmitted for ends of line at a high alternating tension.

Cars used are 50 ft. over all, mounted on Taylor trucks and each equipped with 4 Westinghouse 38 B motors geared to a speed of 45 miles an hour.

On account of the many stops to be made in the length of the line (18), a schedule time of 21 miles in 60 minutes has been adopted.




This is quite satisfactory and fast enough, because the line is a very busy one in two ways. The number of passengers carried is beyond the highest hopes of the management, and it would be impossible to run any more trains over a single track and on train orders than are operated at present. There is every prospect of a second track being laid in the near future. The idea of running steam and electric cars is a novel one in this country, but is highly successful in every respect.

## SPARKS.

The St. John's Electric Company, of St. Johns, Nfld., has sold out to R. G. Reid.

The ratepayers of Nelson, B. C., have sanctioned an expenditure of $15,000 for an electric light plant.

A committee has been appointed by the town council of Stellarton, N. S., to obtain information as to the cost of an electric light plant to be controlled by the town.

J. S. Dennis, a lineman for over fifty years in the employ of the G. N.W. Telegraph Company, was killed in Ottawa recently by the breaking of a pole on which he was working.

The town council of Newmarket, Ont., will ask the Lieutenant-Governor-in-council to authorize an expenditure of $10,000 to increase the electric light plant. If granted, the necessity of submitting a by-law to the ratepayers will be removed.

"Polyphase Electric Currents and Alternating Current Motors," by Silvanus P. Thompson, B.Sc., B.A., F.R.S: This work is of considerable value to the electrical fraternity, as it treats of polyphase currents and alternating current motors and their application to various services in a most exhaustive and thorough manner. The book consists of 508 pages, divided into 20 chapters, and contains 358 illustrations, 24 of them in color, and eight folding plates. There are reviewed such interesting subjects as: Combination of polyphase circuits and economy of copper; structure of polyphase motors; polyphase electric railways; properties of rotating magnetic fields, etc. It is the second edition, and bound in cloth, retails at $5. The publishers are Messrs. Spon & Chamberlain, 12 Cortland Street, New York.

## CONVENTION NOTES.

Mr. E. E. Cary's graphophone entertainments were well attended and much appreciated.

The Association did a fitting thing by recognizing the services of ex-president Yule in connection with the work of the Legislative Committee.

Mr. J. J. Wright, Mrs. Wright, the Misses Wright, and Mr. and Mrs. A. B. Smith went down to the convention in Mr. Wright's yacht, "The Electra."

The evening excursion among the Thousand Islands on board the steamer "America," equipped with a powerful searchlight, was most enjoyable.

During the convention the home of Mr. Fred. Simmons, electrician, Princess street, was decorated especially with variegated colored incandescent lights.

Mr. Higman, of Ottawa, one of the stand-by's of the Association, was among the absentees at this year's convention, having been on a visit to the Pacific coast.

Many regrets were expressed at the absence of Prof. Owen, who was prevented, by the death of his sister, from attending the convention and presenting his promised paper.

The unavoidable absence of Mr. A. A Wright, of Renfrew, and Mr. Geo. Black, of Hamilton, two veteran and useful members of the Association, was the subject of regret.

The weather was a trifle too warm for comfort, and induced a disposition to give the social features preference over business. A cooler month should be chosen for the meeting at Ottawa next year.

The kindness of Chief Hughes in conducting members through the penitentiary and explaining to them the prison regulations, and other interesting features of this institution, was much appreciated.

Everybody voted Mr. Fred. Simmons a "hustler" in behalf of the success of the convention, and withal a jolly good fellow. He was ably seconded by Mr. Nickle, manager of the Kingston street railway.

Mr. Geo. M. DeGinther, representing the Holophane Glass Co., of New York, Mr. Philip H. Hover, of the New York Insulated Wire Co., and Mr. William C. Hubbard, of the Manhattan General Construction Co., of New York, were among the American visitors to the convention.

Mr. Burns, representing Messrs. Munderloh & Co., of Montreal distributed as a souvenir of the convention an attractive and useful pocket match box, having celluloid sides and nickle ends, bearing on one side the Canadian flag and on the other the name of the company and the device "Our lamps are matches—have a light." The company will be pleased on request to send one of these souvenirs to any member of the Canadian Electrical Association who could not attend the convention.

The Packard Electric Company had a magnificent exhibit in the large hall immediately above the council chamber where the sessions of the convention were held. Mr. Cary, the manager, is an adept at arranging exhibits of this kind, having gained his experience in connection with the National Electric Light Association conventions in the United States. The exhibit was most complete and artistic, and attracted much attention and praise. An Italian orchestra formed a pleasing accompaniment. We propose to more fully describe, and perhaps illustrate, this exhibit in a succeeding issue, being debarred from doing so in this number by lack of space.

The platform decoration and exhibition at the city hall—the work of Mr. I. H. Breck, of Kingston, was unique in design and most attractive. On either side of the neatly carpeted stair-way at the top step were two white square pillars. At the base in golden letters were the words "Fiat Lux" (let there be light). Engraved on the left pillar were the well known names of "Volta" and "Frakklin," while to the right appeared those of "Edison" and "Tesla." Surmounting the pillars was an archway made of galvanized iron letters two feet high, and attached to which the word "Welcome," brilliantly illuminated with 72 incandescent lights, blazed forth. Under the archway the typical emblem, a huge naturally tinted maple leaf, was lighted up with the letters "C.E.A." (Canadian Electrical Association) in red, white, and blue lights. Stretching to the right and left were green colored decorations and lights. Each side of the platform was handsomely furnished and carpeted, and lighted with handsome hanging and bracket lamps of the Packard firm, St. Catharines. All at the convention commented on the beauty and originality of design of the display, and citizens were loud in their praise of the exhibit, claiming it to be the best yet seen in Kingston.

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Evidence has recently been taken in the matter of arbitration for the purchase by the city of Winnipeg of the lighting plant now operated by the Winnipeg Street Railway Company. M. J. A. Kammerer, of Toronto, was one of the experts examined.

The exhibitors of electrical apparatus at the Toronto Exhibition just closed were the Royal Electric Company, of Montreal; The Electrical Construction Company, of London, and Jones & Moore, of Toronto. The Royal Company had their usual attractive display, consisting of S. K. C. dynamos, direct current and alternating motors, transformers, arc and incandescent lamps, switchboard apparatus, etc. The Electrical Construction Company exhibited their well-known type of dynamo and several motors. The Goldie McCulloch Company, of Galt, exhibited their Ideal and Wheelock engines, also a number of gas and gasoline engines, which attracted more than ordinary attention.

## PUBLICATIONS.

We have received, through the kindness of Mr. Frank M. Baker, a copy of the report on tests of street car brakes, as conducted last year by the New York Railroad Commission. After making most exhaustive tests, the Board of Commissioners gave the first place to the Electric Selector and Signal Company, second to the Peckham Motor, Truck and Wheel Company, third to the Sterling Supply and Manufacturing Company, and fourth to the G. P. Magann Air Brake Company.

"Modern Electric Railway Motors," by George T. Hanchett, S.B. This work is a discussion of current practice in electric railway motor construction, maintenance and repair, and is so written as to be easily understood by anyone who has had a thorough grounding in Ohm's law. It consists of upwards of 200 pages, abundantly illustrated, and treats of the various designs of motors in a most able manner. The publishers are the Street Railway Publishing Company, of New York.

The General Engineering Company, of Toronto, have just issued their fifth catalogue of the Jones Underfeed Mechanical Stoker, and have succeeded in producing a work worthy of special mention. In it the Jones stoker, improved and perfected, is fully described and illustrated, and strong arguments advanced in favor of the underfeed principle of firing. It also contains numerous statistics of tests, as well as testimonials from persons who have used the Jones stoker in Canada and the United States. The General Engineering Company of Ontario, who control this stoker for the Dominion, is now under the able management of Mr. J. J. Ashworth.

## SPARKS.

The Brandon Electric Light Company, Brandon, Man., have been granted authority to increase their capital from $50,000 to $125,000.

The Canadian Electric Light Company, of Quebec, are arranging to sell power to a pulp company to be established at the Chaudiere Falls.

A motion has been introduced in the town council of Rat Portage, Ont., to enter into arbitration with a view to the purchase of the electric plant of the Citizens Electric Light Company.

At a recent meeting of the city council at St. John, N.B., it was decided to engage an expert to report on the cost of installing and operating a civic electric plant for lighting the streets of the city.

A company has been formed in Ottawa to take over the Conroy electric plant at Dechenes, Que. The capital is placed at $300,000. The power house at Dechenes was built from designs of Wm. Kennedy, C.E., of Montreal, the electrical apparatus being of the Canadian General Company's manufacture.

A school has been established by the United States government at Fort Monroe, Va., for the purpose of instructing regulars in the application of electrical machinery used in the army. The rules, published by the Secretary of War, provide that applicants must be under 25 years of age, unmarried, qualified as a gunner, a student of a correspondence school, or the owner of electrical books, and no applicant will be recommended unless he has sought for a year or more to become practically familiar with one or more classes of electric machinery or with some portion of the elementary literature on electricity.

## MOONLIGHT SCHEDULE FOR SEPTEMBER.

| Day of Month | Light. | | Extinguish. | | No. of Hours. |
|---|---|---|---|---|---|
| | | H.M. | | H.M. | H.M. |
| 1.... | P.M. | 9.10 | A.M. | 4.30 | 7.20 |
| 2.... | " | 10.00 | " | 4.30 | 6.30 |
| 3.... | " | 11.00 | " | 4.30 | 5.30 |
| 4.... | A.M. | 12.10 | " | 4.30 | 4.20 |
| 5.... | " | 1.10 | " | 4.30 | 3.-0 |
| 6.... | No Light. | | No Light. | | ..... |
| 7.... | No Light. | | No Light. | | ..... |
| 9.... | No Light. | | No Light. | | ..... |
| 10.... | No Light. | | No Light. | | ..... |
| 11.... | P.M. | 6.40 | P.M. | 8.40 | 2.00 |
| 12.... | " | 6.40 | " | 9.20 | 2.40 |
| 13.... | " | 6.40 | " | 10.00 | 3.20 |
| 14.... | " | 6.40 | " | 11.00 | 4.20 |
| 15.... | " | 6.40 | " | 11.50 | 5.10 |
| 16.... | " | 9.40 | A.M. | 0.50 | 6.10 |
| 17 ... | " | 6.40 | " | 1.50 | 7.10 |
| 18.... | " | 6.30 | " | 2.50 | 8.20 |
| 19.... | " | 6.30 | " | 4.00 | 9.30 |
| 20.. . | " | 6.30 | " | 4.50 | 10.20 |
| 21.. . | " | 6.30 | " | 4.50 | 10.20 |
| 22 ... | " | 6.30 | " | 4.50 | 10.20 |
| 23 ... | " | 7.20 | " | 4.50 | 10.30 |
| 24.... | " | 6.20 | " | 4.50 | 10.30 |
| 25 | " | 6 20 | " | 4.50 | 10.30 |
| 26 . . | " | 6.20 | " | 4.50 | 10.30 |
| 27 . . | " | 6.20 | " | 4.50 | 10.30 |
| 28 . | " | 7.00 | " | 5.00 | 100.0 |
| 29. | " | 8 00 | " | 5.00 | 9.00 |
| 30.... | " | 8.50 | " | 5.00 | 8.10 |
| 31.... | | | | | |

Total..........186.20

# ENGINEERING and MECHANICS

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ELEVENTH ANNUAL CONVENTION.

The Canadian Association of Stationary Engineers opened its eleventh annual convention in Engineer's Hall, 61 Victoria street, Toronto, on Tuesday, August 28th, at 11 a.m. Mr. James Huggett, president of Toronto No. 1, extended a few words of greeting to the delegates, after which the executive president, Mr. R.C. Pettigrew, of Hamilton, took the chair.

The following executive officers and delegates were in attendance: R. C. Pettigrew, Hamilton, president; G.C. Mooring, Toronto, vice-president; A.M. Wickens, Toronto, secretary; Chas. Moseley, Toronto, treasurer; W. Oelschlager, Berlin, conductor; W. Bear, Dresden, doorkeeper. Delegates—J. Huggett, A. Storer, H. E. Terry, W.J. Webb, N.V. Kuhlman, Toronto No. 1; G. W. Dawson, Hamilton No. 2; A. Ames, Brantford No. 4; R. W. Greene, Guelph No. 6; W. Steeper, Dresden No. 8; W. Oelschlager, Berlin No. 9; W. F. Chapman, Brockville No. 15; J. Uttley, Waterloo No. 17; J. M. Dixson and J.T. Smart, Toronto No. 18

Visitors during the convention included E. J. Philip, J. J. Main, J. W. Marr, W. G. Blackgrove, John Fox, W. Johnson, Geo. Bradley, W. D. Bly, Martin Mose, R. McCauley, P. Jaffnay, Alf. Butcher, S. Thomson, Fred Hamner, Wm. Bourne, W. D. Irwin, and James Bannon, of Toronto No. 1, and T. Graham (president), P. Trowern, H. McMartin, Jos. Hughes, J. Hamilton, W.T. Bateman and J. Richardson, of Toronto No. 18.

The first business of the convention was the appointment of the following committees:

Committee on Credentials—J. G. Bain, C. Moseley, J. Uttley. Committee on Finance—Jos. Smart, H. E. Terry, G. W. Dawson. Committee on Mileage—A. Storer, W.J. Webb, W. Steeper Good of the Order—J. M. Dixon, W. F. Chapman, J. Huggett, A. Ames, W. Bear and W. Oelschlager.

The president then read his opening address, as follows:

PRESIDENT'S ADDRESS.

Brethren,—It is with pleasure that I welcome you to our eleventh annual convention. You have been selected from the different Associations throughout the Dominion to legislate and enact laws for the welfare of the Canadian Association of Stationary Engineers. Before proceeding further, kindly permit me to thank you for the honor you conferred upon me in electing me unanimously to the office of president at our last convention. I can assure you that I appreciate the honor very highly, and while I have endeavored to fill the position in a fitting manner, I fear my efforts were not as successful as could be wished for.

The number of very important questions coming before this convention should receive your earnest and careful attention and deliberation.

The matter of plebicite vote on bi-annual conventions will be brought up for debate.

The report of the committee re bill for legislation is one we should consider well, as this will be the most important matter before us. I trust the committee will have this in detail, as each delegate will have to report to his own association, and it is essential that we keep right on and not give up until we have been successful in having the bill put through in every detail. I may say that within the last two months I have had three men who operate threshing engines inquire of me about certificates, and as to the method of how to go about to get them. This should be very encouraging, as it indicates that even in the rural sections engineers are considering the necessity of qualifying themselves for certificates.

You will see by the secretary's report that we are gaining ground. The old Association has been revised, and charters for new Association have been signed.

At your last convention I must say you made an excellent choice in your selection of a secretary in electing past-presiden Wickens to the office. In conuection with the duties of this office a great amount of work is entailed, and Bro. Wickens has succeeded in keeping in touch with every officer of the executive, as well as each subordinate association.

The lesson papers which were in circutation last winter had the effect of bringing every member to think, and although some are old and scholarly men, there is yet something to learn and to teach. This feature in connection with our Association should be continued every winter, and even should some of the papers and lessons be repeated, there are always young men coming into the Association to whom such lessons would be a material help, as well as having the effect of perfecting ourselves in the different subjects taken up.

Yours fraternally,
ROBT. C. PETTIGREW,
President C.A.S.E.

On motion of Mr. Terry, seconded by Mr. Huggett, the president's address was received and referred to the committee on Good of the Order.

The committee on Credentials presented their report and were discharged. The minutes of the last meeting were read by the secretary and adopted.

SECRETARY'S REPORT.

Mr. Wickens, Secretary, submitted his report, which showed a membership of 239. It stated that a new association had been formed at Vancouver, B. C., and there was a good prospect of one at Sarnia. Ten associations had lapsed. Monthly papers, as ordered by the convention, were issued for five months, and had been of much benefit to the members. The legislative business for the year was strongly pushed by the joint committee of the Canadian and Ontario associations, and hopes are entertained of securing the desired lsgislation at the next session of the House. It was recommended to the convention that the actions of the Legislative Committee of the Brotherhood of Locomotive Engineers, in reference to the legislation asked for by the C.A S.E., be referred to a special committee, with instructions to endeavor to remove the opposition now being put forth by that body. The membership of the Association was shown to be as follows: Toronto No. 1, 124; Hamilton No. 2, 31; Brantford No. 4, 5; Dresden No. 8, 7; Berlin No. 9, 13; Brockville No. 15, 12; Waterloo No. 17, 11; Toronto No. 18, 38; Vancouver No. 19, 16; Calgary No. 1, 9 members—making a total of 266 members, a net gain (after deducting Montreal No. 1) of 27 members for the year.

The secretary's report was referred to the committee on Good of the Order. The report of the Treasurer, Mr. Moseley, showed a cash balance on hand of $202.18. Referred to the Auditing and Finance Committee.

Mr. Terry gave notice of motion that section 1, article 12, of the constitution, be amended by striking out the work "annual," and substituting "biennial," therefor. He also moved, seconded by Mr. Ames, that the present convention be concluded in two days. Carried.

Mr. Dixson gave notice of motion that in future the annual date of meeting be left in the hands of the executive committee, August, of course, being the month for such conventions. Referred to the Good of the Order Committee.

Adjournment was then made until 2.30 p.m. in the afternoon, when business was resumed. The reports of the committees on Mileage, Auditing and Finance were presented and adopted. The report of the committee on Good of the Order was read by Mr. Dixson, as follows:

REPORT OF COMMITTEE ON GOOD OF THE ORDER.

Clause 1.—Resolved, That the president's address was of a hopeful and congratulatoyr character, showing also a careful consideration of the manifold questions affecting the Association's interests.

Clause 2.—Resolved, That the executive secretary's report was complete in the details necessary for our development as an Association.

Clause 3.—Resolved, That C.A.S.E. membership, while not showing a great increase, had been held together firmly, largely by the individual efforts of the executive secretary. We wish to impress upon the members as a society that there are numbers of men in our profession who are eligible candidates for our society, who might be reached by making a united effort to secure them as members. We recommend further, that deputations be appointed from time to time to address mass meetings of engineers

called for that end by the executive, who should be instructed to provide delegates and funds for such purposes.

Clause 4.—Resolved, That the Association, during its efforts to secure legislation at the last session of the House, was materially hindered by the opposition of a sister society, which issued a writtten protest unfavorable to our interests, and while we do not propose to deal with them in the spirit of retaliation, we are of the opinion that they must be laboring under an erroneous opinion to attempt to prevent us from obtaining legislation which would be of universal advantage. We desire to endorse our executive secretary's suggestion that a special committee be appointed to correspond with this sister organization with a view to enlightening them, and ultimately having this opposition removed, and their support obtained.

Clause 5.—Resolved, That the executive be instructed to issue

MR. G. C. MOORING, President.

a strongly worded circular prior to each half-yearly return made by secretaries of primary branches urging the necessity of making such returns punctually.

Clause 6.—Resolved, That the issue of the lesson papers be continued, as apart from their educational value they keep the members in touch with each other, and such cohesive value should not be overlooked. It is also recommended that the papers be mailed to secretaries of the primary branches for distribution.

Clause 7.—Resolved, That the month of August will in future be the month in which the annual convention is held, and we are of the opinion that the fixing of the day or days of the month to hold same shall be left to the decision of the executive.

Clause 8.—Resolved, That the changing of the convention from an annual to a bi-annual session would be detrimental to the growth of our society. The reasons are respectfully suumitted: First, that the organization will be in the course of time very wide in its influence. Second, that the yearly interchange of ideas is a great help. Third, that the bi-annual meeting would mean a lack of interest that would imperil the life of the association.

Clause 9.—Resolved, That the papers be issued to manufacturers and owners of steam plants, such papers to deal with questions, for example, as "Economy in Fuel," "General Saving Effected by the Supervision of a Competent Engineer," etc. We recommend that such papers be gotten up plainly and simply, and in such a general manner that they will impress not only the engineer, but the employer through whose hands they pass. We also recommend a grant of $50 to be used in this way.

Clause 10.—Resolved, That a continued effort be made, both by the Association and its individuat members, to secure such legislation as would be in the best interests of not only the Association, but the public at large.

The above report was taken up clause by clause. Clauses 1 and 2 were adopted without discussion. Clause 3 resulted in considerable discussion, some of the members questioning the wisdom of the recommendation to send delegates to assist in organizing branch associations, inasmuch as a large expense might be incurred, but it was finally adopted upon the understanding that the member living nearest to the town or city should be sent. Clauses 4 and 5 were adopted as presented. Clause 6 brought up the question whether instruction papers should be mailed to the secretaries of the subordinate associations, or whether they should be mailed to each member direct. Mr. Wickens said that in order to place the papers in the hands of the members, it seemed necessary to send them direct. Mr. Huggett said that outside members complained of not getting their papers. Consideration of this clause was deferred until the following morning, and at 4 p.m. the delegates became the guests of the City Council Reception Committee and enjoyed a drive around the city, also visiting the refrigerating plant of the O'Keefe Brewing Company.

In the evening, a public meeting was held in the hall of Toronto No. 18, at which there was a large attendance. An address of welcome was delivered by Mr. T. Graham, president of Toronto No. 18. A paper on "Boiler Construction" was read by Mr. P. Trowern, engineer at the Toronto asylum. Considerable discussion followed, Mr. E. J. Philip taking exception in a friendly manner to some of the arguments advanced by Mr. Trowern. Mr. Wickens also spoke. A vote of thanks was tendered to Mr. Trowern for his paper.

An interesting paper on "Chimney Construction" was presented by Mr. E. J. Philip, chief engineer for the T. Eaton Cnmpany. Mr. Philip has just completed the construction for this company, of a chimney 186 feet in height, with 7-inch flues, and having a total weight of 1,400 tons. It is 16 feet diameter at bottom, and 9 feet 3 inches at top. The base is six feet of concrete. The paper will be published next month.

## SECOND DAY.

Upon resuming business, the discussion on clause 6 of the report of Committee on Good of the Order was continued. Mr. Dixson was in favor of assessing a general tax on the members for the sending out of instruction papers. It was finally decided to continue the sending of papers to the subordinate lodges as heretofore. Clause 7 was adopted without amendment. Clause 8 aroused a lively discussion on the question of annual or biennial conventions. A motion by Mr. Terry, seconded by Mr. Webb, that the clause be streuk out, was lost. Mr. Terry spoke very strongly in favor of a convention every two years, contending that the money thus saved could be expended to better advantage for educational purposes. Mr. Moseley snggested doing away with the the annual banquet, which would reduce the expenses and encourage small associations to hold the annual convention in their towns. The

MR. CHAS. MOSELEY, Vice-President.

clause in favor of annual conventions was finally carried by a good majority. Clause 9 recommended the sending of engineering papers to steam users. Mr. Moseley moved, seconded by Mr. Terry, that the clause be struck out. Lost. Mr. Mooring moved an amendment that the sum of $50 be voted for the purpose, to be used in conjunction with a grant from the Ontario Association. Carried. Clause 10 was adopted, and on motion of Mr. Dixson, seconded by Mr. Ames, the report of the committee, as emended, was adopted.

On motion of Mr. Moseley, Messrs. Dixson, Wickens, Huggett, Webb, Mooring, Dawson, and the mover were appointed a committee on legislation. The convention then adjourned to visit the plants of the

Toronto Street Railway Company and the Toronto Electric Light Company.

A committee was appointed to interview the Canadian Manufacturers' Association, to explain that the C.A.S.E. is an educational body, and that the legislation which is asked for is for the purpose of inducing users of steam power to employ properly qualified engineers.

At 3 p.m. the election of officers was proceeded with, the result being as follows: President, G. C. Mooring, Toronto; vice-president, Chas. Moseley, Toronto; Secretary, A. M. Wickens, Toronto; treasurer, Wm, Oelschlager, Berlin; conductor, Geo. Dawson, Hamilton; doorkeeper, John M. Dixson, Toronto. Votes of thanks were tendered to the scrutineers, Messrs. Trowern, Chapman, and Amber, and the installation of officers was then proceeded with.

It was decided to hold the next convention in the city of Brantford.

The usual grant was made to the secretary.

The retiring president, Mr. Pettigrew, was made the recipient of a past master's jewel. Votes of thanks were then tendered to the city council, the retiring officers, and the mechanical press.

On motion of Mr. Pettigrew, the secretary was instructed to send a letter of greeting to the Canadian Electrical Association in session at Kingston.

### THE BANQUET.

The annual banquet was held at Webb's parlors on the evening of the 29th ultimo, Mr. Huggett, president Toronto No. 1, officiating as chairman. After welcoming the guests, the secretary read letters of regret from Mr. Carscallen, M.P.P., Hamilton; J. F. Ellis, president Canadian Manufacturers' Association; J. R. Barber, M. P., Georgetown; F. R. Latchford, M.P.P.; the Mayor, Ald. Loudon, and others. After the edibles had been disposed of, the toast list received attention. "The Queen" was duly honored. With the toast "Ontario, the Garden of Canada" was coupled the name of Thomas Crawford, M.P.P. He said he recognized the C.A.S.E. as a good society, and had had the pleasure at one time to introduce a bill for the engineers, which, however, did not pass the House. Last year Mr. Carscallen had introduced a similar bill, and he thought results should be attained within a year or two. The legislation asked for was important. From the number of lives depending on the competency of the engineer, it became imperative that legislation should provide that he should be qualified for the position in which he was placed. To the toast "Toronto, the Queen City," Ald. Urquhart and Graham responded. Both recognized the usefulness of the C. A. S.E., and were in sympathy with their movement towards securing legislation. Messrs. Mooring and Moseley responded to "The Executive Council." The latter dwelt on the necessity of educating steam users to employ only competent engineers. In Toronto, he said, thirty-eight boilers were under the sidewalk, and it was absolutely necessary that they should be in charge of competent men. He knew of old boilers that had been taken out of second-hand shops and bricked up, but were totally unsafe. Mr. E.J. Philip was also asked to respond. He said that many thought that the object of the proposed legislation was to make the Association a closed corporation to advance wages, but this was entirely wrong. The public would be the principal gainers, and steam users would be benefitted by having their plants operated more economically. To the toast "Our Guests" Messrs. Steeper, Oelschlager and Pettigrew respoded. The latter pointed out that the Association was not an enemy to the manufacturer. He hoped that other corporations would soon follow the example of Hamilton city council and employ only engineers holding certificates. "Our Rights and Wrongs" brought responses from Messrs. Wickens, Dixon and Main. Mr. Dixon made a most eloquent and hnmorous speech, which was heartily applauded. Toronto No. 1 was then toasted, and proceedings ended by singing "God Save the Queen." During the evening Blea's orchestra rendered a first-class programme of selections, and there were songs by Messrs. W. J. Lawrence, D. C. McGregor, H. B. Short and E. Piggott.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. X. OCTOBER, 1900 No. 10.

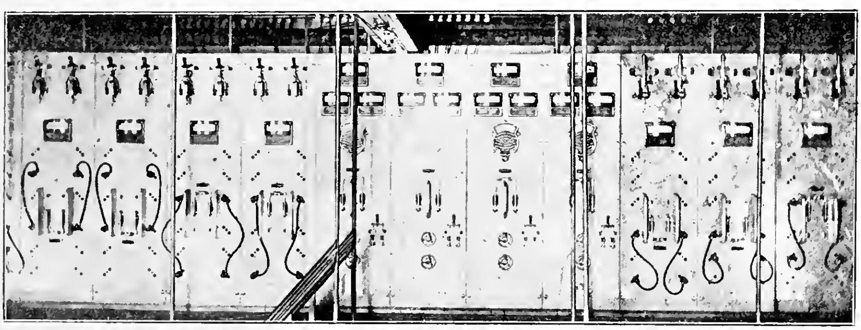
## A MODERN SWITCH-BOARD.

THERE has recently been installed in the station of the London Electric Company, at London, Ont., a sixteen panel switch-board for controlling the alternating output of their plant, which is a splendid example of modern switch-beard construction, containing, as it does, the latest ideas obtaining in this class of work, and being adapted to control not only the present output of the station, but also that for some years to come.

The present alternating generating equipment of the station consists of two 300 k.w. revolving field and two 120 k.w. revolving armature, single phase, belt driven alternators, all manufactured in the Peterborough shops of the Canadian General Electric Company. The engines driving the first two generators are vertical, simple, non-condensing, designed for this plant by Messrs. E. Leonard & Sons, of London, the 120 k.w. generators being at present driven by the "Peerless" type, manufactured by the same firm.

As it is intended that the generator equipment of the plant shall always be four units, the sizes being varied as the output increases, there are four generator panels provided, each capable of controlling a 300 k.w. generator and containing the usual equipment of main ammeter, voltmeter, exciter ammeter, generator switch, ground detector, field switch, and rheostats. Each panel is 80 inches high and 24 inches wide, a size very well adapted to give a pleasing and convenient distribution of the necessary apparatus, and being, for boards similar to this, much preferable to the usual arrangement of a shorter panel mounted on a sub-base. The material is polished blue Vermont marble, adopted on account of its high insulating resistance, and also because it makes a very effective background for the instruments, which are of the Wagner Company's make, finished in dull black and with scales calibrated to suit the particular load on each meter, the voltmeters reading from 90 to 130 volts, which arrangement obviously gives a clear open and easily read scale. The ground detectors are of the Canadian General Electric Company's usual static type, giving a continuous indication of the state of the insulation of all the lines throughout the city.

The generator switches are double pole, single throw and quick break, adapted to handle their rated current without destructive arcing. They are provided with marble barriers between the blades to prevent any chance of short-circuiting a generator when opening its switch, the handles being of the spade type. The field switches have a second set of jaws in addition to those usually provided, which put a resistance in parallel with the fields when the circuit is being opened, so as to take the inductive discharge. There are no fuses, the circuit breakers on the various feeders being relied on to take care of any line short-circuits.

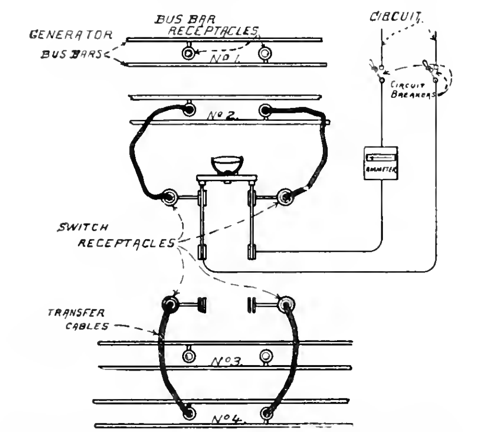


SWITCH-BOARD IN LONDON ELECTRIC COMPANY'S POWER HOUSE, LONDON, ONT.

The feeder panels, twelve in number, of which ten only are at present installed, the balance being added as occasion requires, are placed five on each side of the generator panels, and are of the same height as those for the generators, namely, eighty inches, three of them being twenty-four inches wide and the balance twenty inches. Each panel contains two single pole I. T. E. circuit breakers, mounted, as shown by the illustration, directly on the marble, one ammeter, and, as it was not deemed advisable, for a number of reasons, to parallel the generators, there is provided on each feeder panel one double pole, double throw, quick break switch, with barriers and transfer cables, for expeditiously changing the various circuits from one machine to another, the method of operation being as follows:

The centre studs of this switch are connected each to one of the outgoing feeder wires of a circuit, the two

bottom and two top studs being each connected to a flush mounted plug receptacle. On the back of the board, from end to end, are run eight generator bus-bars, a pair for each machine, each being tapped on each feeder panel to a receptacle similar to that on the switch blades. Now, if any pair of these receptacles be connected by means of cables with suitable plug terminals to either the upper or lower pair of switch receptacles, and the switch thrown onto that pair of jaws, it is evident that that feeder will be connected to that generator in whose bus-bar receptacles the cable plugs were placed, and that the other jaws of the switch will be entirely disconnected. This being so, they can, by means of a spare pair of cables, be connected to any other generator bus-bars desired, and if the switch be thrown the other way the circuit will then be transferred to that generator without interruption to the continuity of the service other than the two or three seconds occupied in throwing the switch. The receptacles connected to the switch jaws with their plugs, being larger than those for the bus-bars, it is obviously




London Electric Company's Switch-Board—Feeder Panel Connections, Showing a Circuit Operating from No. 2 Generator, with Spare Cables in Position to Throw onto No. 4 Generator.

impossible to short-circuit a machine by accidentally plugging cables across its terminals.

To reduce the floor space occupied, and also to give the attendant a clear view of all the machines under his control, the board is mounted on a platform, suspended from the roof timbers by the iron rods shown in the cut, about 12 feet above the floor, access being obtained by stairs, the landing of which is shown in the illustration. It has been in use sufficiently long to thoroughly show its suitability for the service desired, and is now in daily operation, handling the station in a highly satisfactory manner, and demonstrating the many advantages of a well-designed and modern switch-board over the numerous and various complications of old switches and wiring net-works too often found doing duty even at the present day, and which are not only fruitful sources of interruptions to the service, and often of fires, but are also a constant menace to the safety of those handling them.

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The Belgo-Canadian Pulp & Paper Corporation, which purposes establishing pulp and paper mills at Shawinigan Falls, Que., have contracted with the Shawinigan Power Company for 15,000 h. p. of water. The works of the Pittsburg Reduction Company at the above place are nearing completion.

## BY THE WAY.

A fat man who was holding on to a strap in a crowded Philadelphia street car was precipitated into the lap of a lady passenger by the car suddenly rounding a curve. The lady brought an action for damages against the company, for injuries sustained and the jury, after hearing the evidence of the medical witnesses, awarded her $2,300. Street railway companies cannot afford to let the fat men stand, however they may disregard the comfort of the thin ones.

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At the creation of the world two great lights were made, the greater light to rule the day, and the lesser light to rule the night. But there is no night for the lesser light to rule in the Yukon at present. A correspondent writing from Fort Selkirk on the 29th ultimo, writes: "It is now 11 p. m. and I can see to write without a candle. We have daylight twenty-three hours of the twenty-four." It is somewhat confusing to contemplate this nightless, night-capless, nightmareless existence in the golden north, and we find ourselves unable to determine whether its manifest advantages would counter-balance its disadvantages if such conditions of everlasting light prevailed in Montreal at this season of the year. It might lessen the work of the City Recorder, but it would certainly reduce the revenue of the gas and electric light companies.—Insurance Chronicle.

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A gentleman who recently returned from Sault Ste. Marie has told me something about the wonderful progress which that town is making, and which is in a large measure due to the ability and enterprise of Mr. Clergue, manager of the great pulp mills. This gentleman, who, by the way, is a bachelor, lives in a house of the block house type, and on the site where a block-house once stood. The first story of the building is constructed of local red sandstone, and the upper stories of logs or square timbers. Another peculiarity of this residence is that the heating, lighting and cooking are all done by electricity. The proprietor being also the owner of the electrical plant from which the streets and industries of the town are lighted, and of the immense water power by which the electricity is generated, is in a position to adopt this method of heating, the expense of which would be prohibitive in the case of persons less fortunately circumstanced. Speaking of power I am reminded that Mr. Clergue is now developing by means of canals on the Canadian side 80,000 horse power, and on the American side 100,000 horse power.

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The old saying that many a true word is spoken in jest finds an admirable illustration in a quotation from "Punch" of December 30th, 1848, which is published in the London Electrical Engineer. The quotation, which foreshadows the telephone in a remarkable manner, is as follows: "Our attention has been directed to an article made of gutta percha called the telakouphanon, or speaking trumpet, a contrivance by which it is stated that a clergyman having three livings might preach the same sermon in three different churches at the same time. Thus, also, it would be in the power of Mr. Lumley, during the approaching of the holiday time, to bring home the opera to every lady's drawing room in London. Let him cause to be constructed at the back of Her Majesty's theatre an apparatus on the principle of the ear of Dionysius, care having been taken to render it a good ear for music. Next, having obtained an

Act of Farliament for the purpose, let him lay down, after the manner of pipes, a number of telakouphanon, connected (the reader will excuse the apparent vulgarism) with this ear, and extended to the dwellings of all such as may be willing to pay for the accommodation. In this way our domestic establishments might be served with the liquid notes of Jenny Lind as easily as they are with soft water, and could be supplied with music as readily as they can with gas."

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I HAD a funny experience when I first went to Canada," said a well-known telephone engineer who is operating a large exchange in the Province of Quebec. "As you know, Quebec is the headquarters of the French-Canadian, and in the eastern part of the Province there are many people who speak no English ; in fact, there are whole towns full of them. One day I had to go on important business to a little town which we call Ste. Therese. When I found my man there I found also that he could neither speak nor understand English, nor did I at that time know a word of the peculiar lingo that the 'habitant' calls French. What to do I did not know, as no interpreter could be found, and finally, in desparation, I called up the Montreal office and asked for somebody who knew both languages. He came to the telephone, and I told him what I wanted to say to my French friend ; he repeated it to him over the telephone, received the reply and translated it for me into English. In this way we maintained a satisfactory conversation for about half an hour, the interpreter being a good many miles distant from the two men for whom he was rendering his services. I do not know when the telephone has ever been put to a test like this before to show what a polyglot instrument it is."

## SPARKLESS MAGNET COILS.

By James Asher.

It is the purpose of the writer to describe several simple methods of winding eleetro-magnets in order that sparking at the contact maker may be either entirely suppressed or greatly diminished. The first method and the fourth are my own ; the rest, are not generally known.

It is well-known that when the ordinary winding on an electro-magnet is used furious sparking occurs at the contact maker at each break of the circuit. Sparks are generated also at each close of the circuit, but these sparks are comparatively small. Sparking at the contact maker is due to the currents of self-induction, or extra currents in the wire which is wound round the core of the electro-magnet. At closing the circuits these currents oppose the current from the battery, but at breaking the circuit they flow in the same direction as the current from the battery. These extra currents are of considerable tension. The powerful sparking injures the contacts of the contact maker.

First Method.—Two insulated wires of the same kind and length are wound as one strand on the bobbin throughout their entire length. The two ends of one of these wires are firmly fastened together. The two ends of the other wire are connected with the contact maker and the battery in the usual manner. The extra currents in the winding which is connected with the battery are completely annihilated by the induced currents which are generated at their expense in the closed winding, which is similar and similarly situated to the winding which is connected with the battery. Hence we have no sparking at the contact maker.

Second Method.—This was invented by Carlier. It consists in winding the bobbin with bare copper wire, and separating each layer from the next by the thickness of paper. When currents of electricity having low voltage are employed, the lateral contacts of the coils of wire are sufficiently imperfect to prevent much loss of current from the battery by direct flow from coil to coil, while they easily allow the lateral passage of the extra currents, which are always of comparatively high tension. These become self-cancelled in passing through the coils of bare copper wire. Du Moncel states that this method is very effective, and he expresses his surprise that it has not been more frequently employed. Perhaps if the wire were dipped into very thin varnish before winding it upon the bobbin, we might use the magnet in connection with a battery capable of generating an electric current of high voltage.

Third Method.—The magnet has two separate windings of the same length and of the same kind of wire. These two wires should be wound together as one strand on the bobbin throughout their whole length. The two ends of one wire are fastened to the terminals of the battery, consequently there is a closed circuit during the whole time of operating the electro-magnet. The two ends of the other wire are connected with a circuit closer and the battery in the ordinary manner. The connections of the two wires are made in such a manner that the current in the winding connected with the contact maker flows round the core in the opposite direction to that of the current in the other winding, which is unconnected with the contact maker. The two equal currents, passing round the core in opposite directions, fail to develop magnetism in the iron core of the electro-magnet. On opening the circuit of either of these wires the core instantly becomes magnetic. The effect on the core is directly opposite to that in the common method. We get absolutely no spark whatever at the contact maker, either at break or at close of circuit, according to Professor Silvanus P. Thompson.

Fourth Method.—Two insulated wires of the same kind and of the same length are wound together as one strand on the bobbin. The first two ends of the wire are fastened to a wire which extends to one binding screw of the battery. The last two ends of the wires are fastened to a wire which extends by way of the contact maker to the other binding screw of the same battery. The extra currents in the two windings at breaking circuit are neutralized by their mutual reactions.

Fifth Method.—This was invented by Billet, and described by Du Moncel in his book which is entitled "Electricity as a Motive Power." Each leg of the magnet has two bobbins of wire. The two ends of wire at the middle of each leg of the electro-magnet are joined to the two ends of wire at the middle of the other leg of the electro-magnet. The other two ends of wire on one core are connected with one terminal of the battery and the two corresponding ends of wire on the other core are connected with the other terminal of the same battery. A contact maker is interposed. The extra currents at breaking circuit are suppressed by their mutual inductive reactions. The extra currents at closing circuit, however, are not destroyed by this method. Consequently a small spark appears at closing circuit.

Sixth Method.—This was invented in England by W. Langdon-Davies. Each wire is wound as only one layer and the ends are allowed to slightly project. After all the layers have been wound the separate ends on one bobbin of the electro-magnet are joined to a wire which constitutes one terminal of a battery, while the separate ends of the wire on the other bobbin are joined to a wire which constitutes the other terminal of the same battery. On interrupting the current in either terminal the sparking is found to be weaker than usually is the case. The extra currents in the different layers of wire are not quite simultaneous, because the layers are at different distances from the core.

Seventh Method.—This was invented by an American named Paine. After winding each layer of wire round the bobbin a sheet of tinfoil is wrapped round the layer. At breaking and at closing circuit the extra currents in the wire induce currents in the sheets of tinfoil. In consequence, sparking at the contact maker at each break and at each close of circuit is greatly diminished.

Eighth Method.—A sheet of copper is wrapped round the bobbin before the wire if wound on. At breaking circuit induced currents are generated in the copper sheath. The sparking at breaking circuit is considerably weakened. Currents are generated also in the sheath at closing circuit. The sparking at closing circuit is weaker than usual. This method is believed to have been either invented or adopted by Mr. Charles F. Brush, of Cleveland, O.

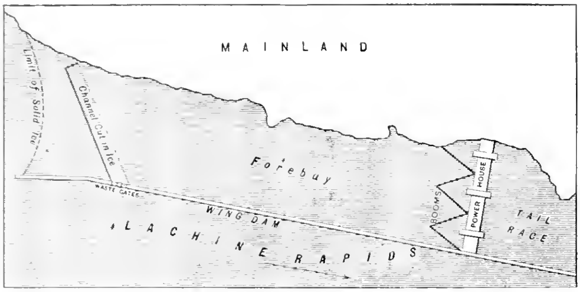
The Miner-Graves Syndicate have under consideration a project to transmit electric power from Grand Forks to Phoenix, B. C.

The city engineer of Toronto has submitted to the city council estimates of the cost of installing and operating a telephone system. For 6,000 subscribers he places the cost of installation at $675,000, and the annual cost of operating, including depreciation at five per cent. and interest at 3½ per cent., at $120,000. For a system for 10,000 subscribers the cost of installation is given as $1,120,000, and annual cost of operating $205,000. These estimates are based upon a common battery switch-board.

## THE LACHINE RAPIDS ELECTRICAL TRANSMISSION PLANT.

In the Electrical News of October, 1897, there appeared a general description of the electrical power plant of the Lachine Rapids Hydraulic & Land Company, of Montreal, then nearing completion. Since that time some improvements have been made, and we are now enabled to present to our readers a description in greater detail, which will doubtless be of interest.

Hydraulic Development.—The St. Lawrence river is divided by a long, narrow island at a point above the city of Montreal into two channels. The two streams taken together are known as the Lachine Rapids, and it is in the northern of the two streams that the power development has been made. Parallel with the shore there has been erected a wing dam 5,200 feet long, of cribwork composed of 12 in. x 12 in. timbers, faced with three inch plank and filled with rock. Between this dam and the shore the distance is 1,000 feet, and across the canal thus formed




Sketch Map, Showing Limit of Freezing in the Lachine Rapids Forebay.

is built a solid masonry dam upon which is located the power house. The tail race is 1,400 feet wide, and the forebay or upper part of the channel about 4,000 feet long, 1,000 feet wide and 13 feet deep, the velocity of the water through it being two feet per second. There is a system of booms so arranged that all rubbish is carried away by the three waste gates in the main dam. The general situation may be understood by referring to the accompanying map. The total available fall varies up to about 16 feet.

Frazil Ice.—The difficulties from frazil and anchor ice were in a large degree overcome by having a large enclosed area of still water, which would freeze over early in the winter, making it impossible for frazil or anchor ice to form under such cover. Frazil ice formed in the rapids above the enclosed area of still water. This obstacle was met by the fact that the natural current of the river, varying from 15 to 20 feet per second, would be deflected into the open river on meeting the frozen surface and would carry all frazil along with it. But during the winter of 1897-98 trouble was experienced from both frazil and back-water. The cause of the frazil ice was the previously unknown existence of a reef which projected past the wing dam and against which the frazil, in being swept onward with the current, adhered, producing anchor ice. This formed a natural dam, throwing the frazil into the head race instead of carrying it into the open channel beyond. During last year improvements were made which are said to have eliminated all further troubles from anchor ice. The wing dam was raised and extended a distance of 1,000 feet, thus enclosing a greater body of water. A pier was also erected some 7,000 feet above the power house, projecting 1,000 feet from the river bank, thereby diverting the original course of the river and causing it to flow towards the main channel and away from the head race. In addition, sluices have been left in the wing dam which, should occasion require it, may be used for ridding the head race of any anchor ice that may be forced into it when the river above is completely blocked with ice. To overcome the trouble from backwater the tail race was extended and deepened and an extension made to the wing dam.

The Power House.—The power house is a steel building 1,000 feet long by 40 feet wide, and consists of three dynamo rooms 65 x 45 feet, and a similar number of turbine sheds. The floor is of concrete with 1½ inch slate, the whole being supported by steel beams. The building is heated electrically, each room being supplied with coil heaters.

Turbines.—The hydraulic equipment consists of 72 54-inch Victor turbines, vertical, cylinder-gate type, capable of developing, under 14-foot head, about 300 h.p. Under the low head of 8 feet the wheels will develop 135 h.p. They are set in flumes, the wheels resting on wooden floors communicating with the tail race by means of short steel draft tubes. The wheels are set in sets of six in two rows, all six of each set driving by bevelled gearing a single shaft, which is direct coupled to the revolving field of one of the dynamos. A single governor controls the gates of all six wheels, the driving being accomplished by means of a wooden tooth gear on the wheel shafts meshing with cast iron pinions on the horizontal line shaft which runs to the dynamo. Two types of governors are used, the Giessler electro-mechanical governor, built by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and the Lombard governor, manufactured by the Lombard Water Wheel Governor Company, of Boston, Mass. Iron head gates are placed at the entrance to cut off the water supply in case of necessity, and iron racks prevent debris and floating matter from being drawn into the wheels. An ingenious system of signals is used between the switchboard and the governor station in the wheel rooms, the invention of Mr. R. S. Kelsch, superintendent of the plant. When a machine is being brought into circuit signals are exchanged by means of colored lamps between the control table in front of the switchboard and the wheel station, these signals being wired in such a way that a signal must always be repeated back to the senders before it can be obeyed.

The Generators, Etc.—Each battery of six wheels is direct coupled to a generator of the three-phase type, manufactured by the Canadian General Electric Company. There are 12 generators in all, with revolving fields, forty poles, giving 750 kilowatts at 175 r.p.m. They are wound to deliver 99 amperes with a frequency of 60 cycles per second at 4,400 volts directly to the transmission lines, no interposition of step-up transformers being needed. The winding is of the usual wire coiled type and is ranged in one slot per pole per phase. Each generator is direct connected to its jack-shaft. All of the field coils are connected together in series. The exciters consist of six Canadian General Electric machines, four polar, 75 k.w., 150 volt, direct current, compound wound, operated at 660 r.p.m. Each pair of exciters is driven by an independently governed water wheel. The wheel used for this purpose is one of the six 300 h.p. wheels for operating the generators, the last wheel of the series having been detached from the generator shaft and belted to one exciter. Each exciter is sufficient to operate the whole four machines in the dynamo room.

The Switch-Boards.—The switch-board as at present installed contains seven panels, each 36x52 inches, with sub-panels, 28x36 inches, all mounted on slabs of blue Vermont marble two inches thick. The two outer panels, one at each end, are for light and power, there being two separate sets of bus-bars for

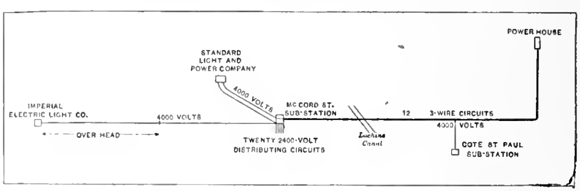



Diagram of Transmission and Distribution Circuits from Lachine Rapids Power House and in Montreal.

this purpose insulated with heavy rubber and tested to 10,000 volts. These panels each contain three ammeters, a direct reading voltmeter, three single blade, double-throw, quick-break, high tension line switches, and two static ground protectors. The next two panels on each side are for the four generators, and each contains three synchronizing lamps, two ammeters and a field switch. The center panel controls the exciter and contains three Weston ammeters, a voltmeter, two alternating voltmeters, and two triple-pole, double-throw switches. All high tension fuses are situated on the back of the board and near the top, so that in case of a fuse blowing no damage is done either to the board and apparatus or to the attendant. The back of the board is interesting. The bus-bars are of copper cable covered with hard rubber tubing and caps. There are two sets of these bars, and

any machine may be thrown upon either at will, as may any of the transmission circuits to the city. In this way practically any combination of machine and circuit can be made. Situated in front of the switch-board is a marble table on which are placed the signalling apparatus by which the switch-board attendant can give or receive any signal necessary between the switch-board and the turbine shed. The regulating device consists of the four field rheostat handles, the exciter rheostats, the synchronizing switch and the four switches for operating the emergency switches of the oil type, worked by compressed air and placed one in each generator lead in the basement below the switch-board. The lightning arresters are of the Wirt 5,000 volt type, connected in delta between the three phases. It is understood that it is the intention of tne company to replace the present switch-board with one of more elaborate construction and design.

THE POLE LINE.—From the power house a line 32,000 feet long is laid to the main distributing station at the corner of McCord and Basin streets, in the city of Montreal. It consists of 12 three-phase lines of No. 0. B. & S. bare copper wire, mounted on triple petticoat porcelain insulators carried on 4x4 inch wooden cross-arms, on steel poles. These poles are of latticed iron, 35 feet long, imbedded six feet in concrete, foundation 2x3 feet, and spaced 100 feet apart. The line drop is 14 per cent. of full load. The twelve lines are all operated in parallel, though they can be subdivided in any way desired. When the corporation limits are reached the wires are placed undergound. They converge into a paper covered lead armored cable, one circuit in each, the insulation being 7-32 inch, and tested to withstand 15,00 volts. They cross ten feet below the bed of the Lachine canal, and 33 feet below the water level, in three inch cement lined iron pipes, of which there are 24, and thence to the sub-station not far distant. At an intermediate point a short line branches off to the Cote St. Paul sub-station.

THE SUB-STATIONS.—The main sub-station, corner McCord and Seminary streets, is a two-story brick structure. From the underground conduit running into the basement of this building, the transmission line passes to the high tension switch-board, and after passing through the aluminum line fuse it reaches the high tension switches, then the step-down transformers, of which there are three of 150 k. w., and four of 250 k. w., of the self-cooling oil type, one of the latter being in reserve. By these the voltage is reduced from 4,000 to 2,400. There are also three transformers of 30 k. w. each, of the self-cooling oil type, used as boosters. The transformers were built by the Wagner Electric Manufacturing Company, of St. Louis. In the Cote St. Paul station the equipment consists of Manning boilers, Westinghouse engines, two Walker and two General Electric synchronous motors, usually to operate three 125 arc light Wood machines, which are at present run from the jack shaft in the power house to light the streets of Westmount, one of the western suburbs of Montreal.

DISTRIBUTION.—The method of distribution will be understood by reference to the accompanying diagram. From the main sub-station the primary distribution is carried over the entire city in underground conduits containing from 8 to 63 ducts of 3-inch cement lined iron pipe, in which three phase wires varying from No. 3 to 0000 B. & S. are placed, each in a paper insulated lead armored cable manufactured by the National Conduit & Cable Company, of New York. The manholes in the street are each covered with a heavy iron cover. Ventilation is maintained by running pipes to the street pole. Cables are carried above ground from the conduits for the ordinary overhead distribution to feed areas of half a mile radius. The main sub-station supplies twenty 2,400 volt distributing circuits throughout the city, and also supplies one 4,000 volt circuit to the Imperial & Electric Power Company's station in the eastern end of the city, where the current is used to operate synchronous motors driving the electric light machinery, and two circuits to the station of the Standard Electric Light & Power Company, where one is transformed to operate two rotary converters feeding a 500 volt, three wire, direct current motor circuit in the business portion of the city, while the other operates a synchronous motor for driving arc lighting and other dynamos. These 4,000 volt lines are tested at the sub-station through two sets of 30 kilowatts transformers in parallel with one another, but in series with the line. On account of the extensive nature of the city, and the many trees it contains, the secondary net work is of unusual size. It is maintained at 110 volts, and small induction motors are fed at this pressure, the larger ones generally employing the 2,000 volts current of the intermediate distribution.

RESERVE.—To provide for accidents, the company have installed at the Cote St. Paul and Chenneville streets sub-stations a reserve steam plant which will be brought into use in case the water power plant is compelled from any cause to close down.

THE LOAD.—The load on the company's system is about 75,000 incandescent lamps, and between 2,500 and 3,000 horse power in motors, both synchronous and induction. The rate for lighting is ¾ of a cent per sixteen c. p. lamp-hour, with a discount of 20 per cent. for prompt payment. For large consumers under contract the rate is reduced to ½ cent per lamp hour; this corresponds to 9.4 and 7.8 cents per k. w. hour respectively, four watt lamps being used. The rate for power varies from $82 per horse power per year to $32 per horse power for large machines.

## THE REASON WHY SOME BELTS DO NOT GIVE BETTER SATISFACTION.

BY E. H. NEWTON.

WE often hear this or that particular brand of belting condemned because it did not give satisfaction. Some men prefer leather for all purposes, while others are partial to some other kind. If we study the conditions under which one belt will work better and last longer than another, we will find that most belts are good if the proper judgment was exercised in their selection for the work they are intended to do. The fact that a leather belt will not last in a damp place or where it is exposed to wet is no reason why the use of leather belting should be discouraged, for under favorable conditions there is nothing better than a good leather belt. On the other hand, if a rubber belt has been run where oil got on it, destroying its good qualities, or the edge has been allowed to rub against something until it is worn through, allowing the belt to separate, or, as is too often the case, the belt is too light for the work and a gum or resinous substance is used to make it stick to the pulley—under such conditions good results will never follow, for I know of no better way to destroy the life of a rubber belt than to use oil or gum on it. I have seen the rubber peel clean off the inside of belts and stick to the pulleys by the use of resin and oil. In many mills incompetence does more to destroy the belt than the work if it was properly adjusted and cared for.

I once knew a man to use up five leather belts in succession in one season, where water was allowed to get on them. The next season a rubber belt was put on the same place and covered so that it was kept dry, and at the end of the season it was nearly as good as new. Had this precaution been taken when the first leather belt was put on, the result would have been equally satisfactory.

Much care should be exercised in selecting belts heavy enough to transmit sufficient power without being run too tight. If a wide belt cannot be used and a narrow one is not able to do the work, increase the diameter of the pulleys proportionately and you will overcome the difficulty. When a thick belt is run at high speed over a very small pulley with unfavorable results, if a wider and thinner belt cannot be used, increase the pulleys also, and note the improvement.

The lacing has quite a lot to do with the life of a belt, as when a belt is not properly laced the holes soon tear out, destroying the belt. I lace in three different ways for three different kinds of belt, namely, very thick, medium to thin, and cross belts. Thick belts, being usually run on large pulleys, work well with the straight lace. Thin belts on smaller pulleys work best with what I call the interwoven lace, as laced in this way the holes never tear out. But for a cross belt, rubber or leather, I prefer the lacing known as the "boot-leg," as the lace cannot wear when the belt rubs together, and laced in this way any cross belt will work well.

A company has been formed at New Denver, B. C., to light the villages of New Denver and Silverton by electricity.

According to the coroner's jury, an electric shock, due to a defective transformer, caused the death of Mr. H. B. Davidson, manager of the electric company at Selkirk, Man. The verdict concludes: "We are of the opinion that to avoid contact with the ground by any person or persons, that floors of the electric station should be insulated in the pump rooms and around the dynamos and switchboards, and that vulcanized sockets only be used in damp places, all machinery duly safeguarded by railings and other protection, and that for the protection of the public, a government inspector of electric light and power houses should be appointed, and all electric appliances tested."

## EXHIBITS AT THE C. E. A. CONVENTION.

We publish in this number two views of the principle exhibit at the convention of the Canadian Electrical Association held recently in Kingston. This is the first year in which exhibits were made under the auspices of the Association. Unfortunately, when it was decided that an exhibit of electrical apparatus should form a feature of the convention, the time was very limited for manufacturers to prepare their exhibits, and a number who intended to exhibit, and no doubt will in the future do justice to their apparatus and supplies, were prevented on account of the season of the year from making an exhibit.

The Packard Electric Company, of St. Catharines, made a special effort, and in conjunction with their allied interests, consisting of Mr. R. E. T. Pringle, of Montreal, The C. P. Company, of St. Catharines, and the Hamilton Electric Supply & Construction Co., of Hamilton, had a handsome exhibit of the various apparatus and supplies made and sold by them. The exhibit, as shown in the illustrations, was arranged in a square 30 feet x 30 feet, with four entrances, the centre of each side. Uprights at the entrances and at each corner extended 18 feet above the floor. From the entrances to each corner there was a broad counter upon which various detailed supplies, coils of transformers, and meters, were exhibited. Within the exhibit were several summer couches, easy chairs, and various kinds of refreshments for the inner man. In the centre of the exhibit was a fountain eight feet in diameter at the base, the spray being ten feet above the floor. This was strictly an electric fountain of the rustic type, which, together with the plants and vines by which it was surrounded and covered, produced a very artistic effect, as underneath the water shone the radiance of 100 green lamps.

Probably the most interesting part of the exhibit was that of the new type "E" Scheeffer recording watt-meter for alternating current. This exhibit involved a number of instruments and was so arranged that an inductive and non-inductive load could be thrown instantly upon the meter which was being tested. Upon inductive loads, by means of a Stillwell regulator, the power factor could be varied from .30 to .90. Then the same load in watts upon incandescent lamps could be thrown upon the meter and readings taken. The meter was of small capacity, being the 10 ampere, and notwithstanding the small size involved, the results by actual test showed the meter to be correct within one-half of one per cent. upon the two loads with the varying power factor, as above stated. Several managers of prominent central stations in Canada took pleasure in making personal readings, and apparently the type "E" Scheeffer watt-meter solves the question of accuracy upon inductive and non-inductive loads, which has been carefully experimented with and sought for by several of the larger makers during the past two years. Doubtless other prominent makers have succeeded in accomplishing the same results, but this was the first actual test in Canada exhibited to the assembled fraternity.

Upon another counter was exhibited the flat, or pan-

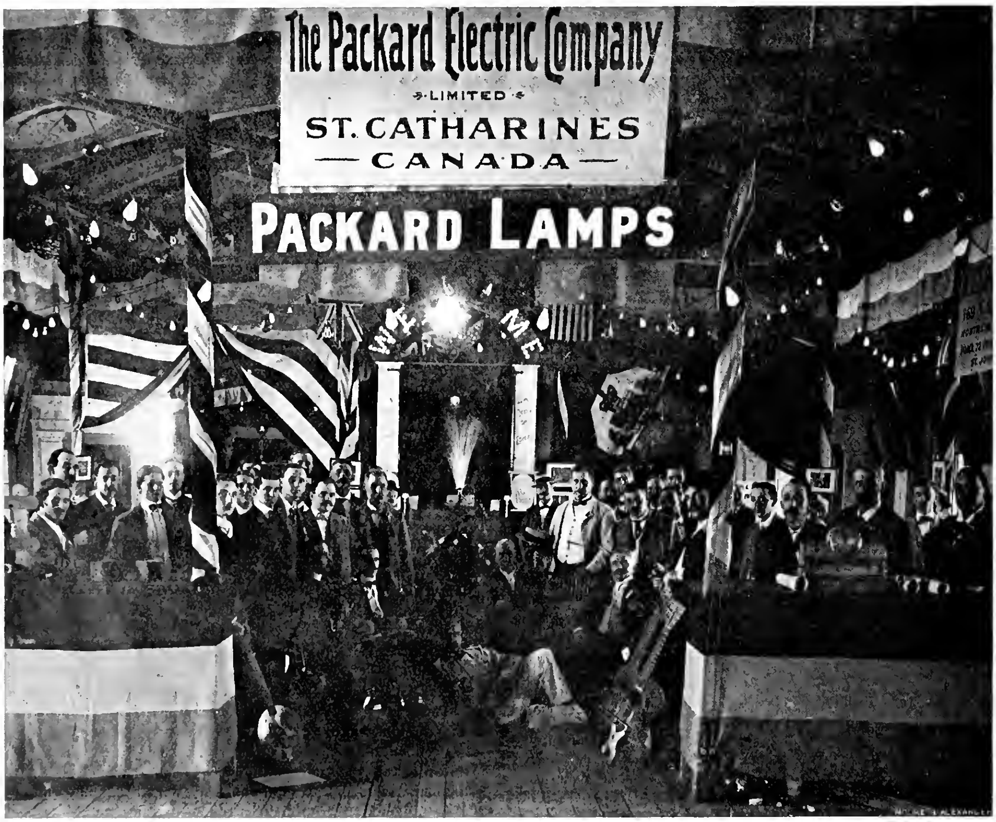



Exhibit of The Packard Electric Company at Canadian Electrical Association Convention, Kingston, 1900.

cake type of coil, which the Packard Company now use exclusively in all sizes of their transformers from 1.5 k.w. to 150 k.w.

The C. P. Company exhibited various supplies of a hundred and odd varieties which they are now manufacturing in the works of the Packard Company at St. Catharines.

Arc lamps, both series and for direct current, and multiple lamps for direct and alternating current, were exhibited also by the C. P. Company.

In addition to the exhibit of the above mentioned companies, Mr. Frank Martin, of the Hamilton Electric Light & Cataract Power Co., exhibited his register for central stations, which registers the current in amperes upon a chart, by which can be readily calculated the total energy of the output of a central station for 24 hours. These charts are very interesting; the register is very ingenious and doubtless will become in popular use.

A new enclosed magnetic type of lamp invented by Messrs. Martin & Stuart, of Hamilton, was exhibited, and one illuminated the interior of the exhibit, being placed directly above the fountain. Bunting and flags of Great Britain and the United States were plentifully used and lent an artistic appearance to the whole exhibit. Two large flags, one being the Union Jack and one Old Glory, were entertwined in the rear of the exhibit as one entered it through the main entrance of the City Hall, and between them was a banner with the motto "L'Union fait la force." Over 500 incandescent lamps illuminated the exhibit at all times.

Exhibit of The Packard Electric Company at Canadian Electrical Association Convention, Kingston, 1900.

## NEW APPOINTMENTS AT THE KINGSTON SCHOOL OF MINING.

Several new appointments have recently been made in the Kingston School of Mining. Mr. L. W. Gill, B. A. Sc., has been appointed to the new chair of electrical and mechanical engineering. Professor Gill is a distinguished graduate of McGill University. After graduation he studied for two years as Exhibition Research Scholar, and had the distinguished honor of being offered the Scholarship for a third year. This scholarship is of the annual value of 150 pounds sterling, and is awarded by Her Majesty's Commissioners from funds remaining from the receipts of the Exhibition of 1851. Mr. Gill's work as research scholar was carried on partly at McGill and partly at Harvard University. Since the completion of this work he has been in the emplov of the Westinghouse Company, Pittsburg.

Dr. John Waddell, B. A. Sc., Ph.D., has been appointed lecturer on Industrial Chemistry, and Mr. C. R. McInnes that in Applied Mathematics.

Mr. A. G. Burrows, M.A., has been appointed demonstrator in Mineralogy, and M. B. Baker, B. A., in Geology.

The Mining Laboratory has been rebuilt so as to give twice the space for machinery and a lecture room and testing laboratory. The Carruthers Science Hall has been improved by the addition of a ventilating system, controlled by fans, for removing the foul air and replacing it with pure warm air.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y

of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,

Corner Yonge and Richmond Streets,

TORONTO, - - CANADA.

Telephone 2362.

BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.

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***SUBSCRIPTIONS***

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**Governmental Management of Telegraphs.**

SINCE 1870 the control and management of the British telegraph system has been vested in the government. The effectiveness of the service seems to leave little ground for complaint, but from a financial point of view the results are entirely unsatisfactory and calculated to make other countries think twice before adopting the system. While the system was being conducted as a private enterprise it paid dividends of 8 to 14 per cent. Since the government assumed control, however, there have been large deficits almost every year. The shortage last year on a total business of three and a quarter million pounds amounted to more than half a million pounds. The aggregate of these yearly deficits has now reached seven and three-quarter million pounds. The astonishing feature of the case is the fact that the volume of business and receipts has largely increased.

**Electricity vs. Gas.**

AN interesting paper on the above subject was recently presented by Mr. White, of Cincinnati, before the Ohio Electric Light Association. The figures which he gives prove conclusively the advantages of electricity over gas for street illumination. He showed that in about 60 per cent. of the cities of over 25,000 inhabitants in the United States gas had been entirely discarded in favor of electricity for street lighting purposes. In the other 40 per cent of the cities electricity is used to a greater or less extent and is steadily growing in favor. In only one city has electricity been replaced by gas, and it is said that the explanation of this bears a close relation to the politics of the city. The figures regarding the economy of the two kinds of illumination are particularly timely, and show that electric light is the cheaper. The cost in Chicago, from official figures, is $784.60 for gas lighting per mile and $567.45 for electricity, while the brightness of illumination of the latter is much superior to that of the former. Mr. White submitted the statement that one arc of 890 actual useful candle power will give as much light as 20 Welsbachs of 40 candle power.

**Employment of Incompetent Attendants.**

THE employment of persons incompetent to perform the duties expected of them is an evil which exists, perhaps, in a greater or less degree, in every branch of industry, and is therefore not altogether foreign to the electrical business. The claim has been made that the manufacturing companies are encouraging the employment of incompetent workmen as engine and dynamo tenders. The severe competition that is encountered and the desire to effect a sale is apt to induce salesmen to lead thier customers to underestimate the cost of attendance necessary for the successful and economical operation of apparatus. A certain firm in Toronto who are the owners of an isolated electric light plant are said to have engaged to operate the plant a cheap and inexperienced engineer. The mistake thus made was soon discovered and a competent engineer substituted. It has been stated that the builders of the engine were responsible for the employment of the first engineer, because they understated to the owner the amount of skill and attention that the plant would require. The necessity is apparent that manufacturers of electrical and steam apparatus should guard against having the reputation of their goods suffer as the result of inexperienced attendance. Cheap labor around an electrical

or steam plant invariably means that the saving effected in salaries will be more than offset by excessive operating expenses.

**Effect of Snow on Telephone Wires.**

Experiments to determine the effect of snow on telephone wires have recently been made by Mr. E. Pierard, a telegraph engineer of Belgium, the results of which are interesting. He found that a bronze wire 2 mm. in diameter collected an ovoid of snow, whose two axes were respectively 28 mm. and 36 mm. The weight of the snow was, roughly, 1.78 times that of the wire. A smaller wire 1.4 mm. in diameter collected an envelope of snow 4.38 times its own weight. The result of this snow collecting on the wires running from the central office in Brussels imposed an extra weight of over 30 tons on the supports. In calculating the deflections produced by the heavy coats of snow the author found that in many cases the long spans were safer than short ones. This was because the long spans sagged sufficiently to enable the central portions to find additional supports on house ridges, etc. As an example of what these sags would be with the weights mentioned above, the author found that with a syan of 100 yards there was a sag of four yards, with a span of 550 yards the sag was about 25 yards.

**Electric Lighting Statistics.**

At the annual convention of the National Association of Officials of Bureaus of Labor Statistics of the United States, held in Albany in June, 1896, a committee was appointed to undertake an investigation of the private and municipal ownership of water, gas and electric light plants. This committee recently submitted the results of its investigations, which are published as the fourteenth annual report of the Commissioner of Labor. The general impression is that one of the main objects of the report was to prove the advantage of municipal as compared with private ownership. There seems no reason for dissatisfaction so far as the abundance of information in the report is concerned, it being perhaps quite as complete as could be expected, considering the many difficulties met with in gathering information of this character. It is equally true that the results neither prove nor disprove the claim that municipal ownership is more economical than private management. Neither is it difficult to discern that the compilers of the report were partial to municipal ownership, hence their statements should, in our opinion, be discounted. We will not attempt to make deductions from the numerous tables bearing upon the cost and operation of electric light plants, this being well nigh an impossibility, but some of the figures given in the introduction and analysis of the tables are of peculiar interest. It is shown that in the United States there are 965 gas plants, of which but 14 are under municipal control. The number of electric light plants is 3,032, of which 460 are municipal and 2,572 private. The report covers 320 municipal and 632 electric light plants, or about 35 per cent. of the total number in the United States. The capacity of the electric lighting plants has been given by taking the rate of horse power of the engines as the basis. It is noticeable that municipal ownership is most common in respect to small plants. Of those of 50 h. p. investigated by the committee, 9 were municipal and 6 private; of 100 to 125 h. p., 13 were municipal, and 10 private; 200 to 300 h. p., 14 municipal, 19 private; 500 to 750 h.p., 7 municipal, 57 private; 1,000 to 1,500 h. p., 4 municipal, 34 private; while of 5,000 h.p. plants, none are owned by municipalities, and 15 by private interests. This is also shown by the invested capital, 320 municipal plants representing an investment of $10,908,925, and 632 private plants an investment of $113,917,815. The cost of producing electric light is gone into at some length. In this one of the largest items is, of course, the salaries and wages account. This is divided into two sections, that of salary including the remuneration to officers, superintendents, clerks, etc., and that of wages being the amount paid for engineers, firemen, dynamo tenders, linemen, and like help. In seven of the groups shown the average cost for wages exceeds that in the private plants, while in eight of the groups this item in the private plants is greater than in those municipally controlled. On the other hand, the average cost for salaries in municipal plants is smaller in every instance than in private plants, in some cases being less than one-half. This is, indeed, a strange anomaly, and somewhat contradictory. It is in calculations of this sort that the advocates of municipal ownership find ground on which to base their so-called arguments. Municipal electric light systems are frequently operated as an adjunct to other plants, making it possible for those so inclined to charge an unjust proportion to the cost of operation.

## ANCHOR ICE AND ELECTRICITY.

A novel use has been found for an electrical stove by the Water Board of Marquette, Mich. The stove has been put in the intake pipe which supplies the water to the city works from Lake Superior, and its purpose is to keep anchor or needle ice from forming on the sides of the pipe and finally stopping the flow. The stove is the invention of the superintendent of the local electrical plant. It is a resistance coil like those used for heating street cars, and is made in circular form to fit within the intake pipe, the water passing through it. Current is furnished to the stove at slightly above one hundred volts, and the plan is to keep it in constant operation when weather conditions are favorable for the formation of needle ice. It is not necessary that any great quantity of heat should be generated, a rise of two or three degrees being sufficient to melt the ice as fast as it forms. The cost of the apparatus is $25, and this expenditure will save at least $100,000 for a new and deeper intake.—N. Y. Evening Post.

## THE NERNST LAMP IN GERMANY.

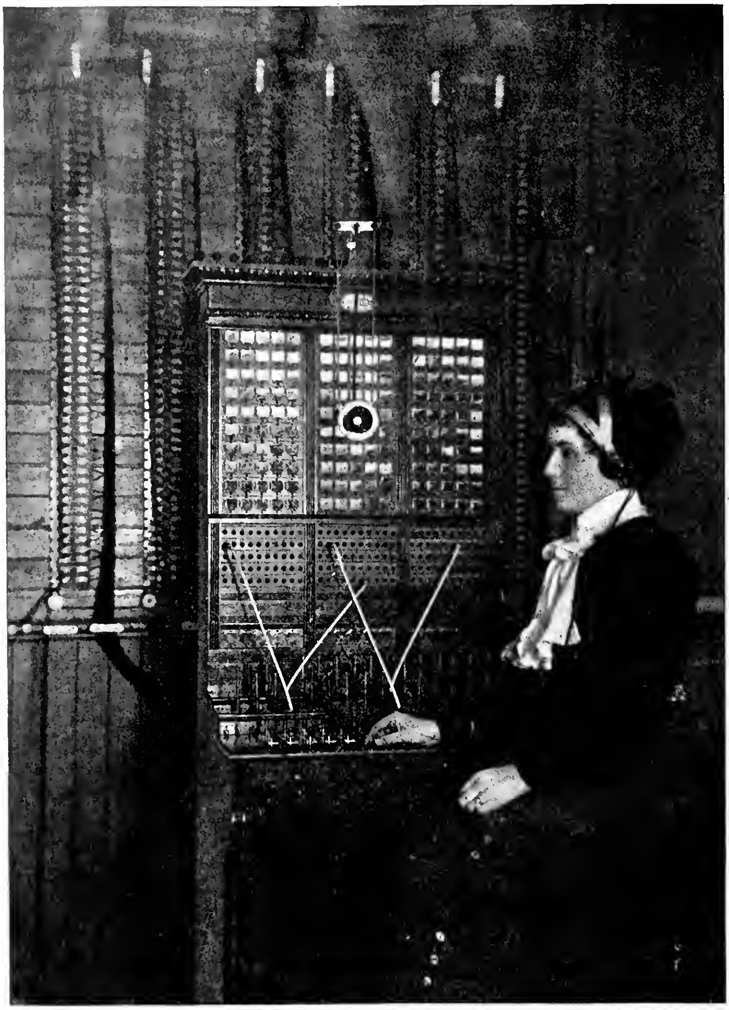
From a lecture given by Dr. Nernst in Berlin it appears that Nernst lamps are now being made by the Allgemeine Elektricitats Gesellschaft in 25, 50 and 100 c. p. sizes, with a life of about 300 hours and an efficiency of 1½ to 1¾ watts per candle power. Experiments are also being made with lamps of higher candle power. The wholesale manufacture of 110 and 220 volt lamps will be commenced as soon as the new works, which are being erected by the company for that purpose, are completed. The German patent office has dismissed all petitions against the validity of the Nernst lamp patents.

The town of Berlin has given a contract to the Berlin Gas & Electric Co., for electric and gas lighting for a period of five years from October 1st, 1900.

## A CIVIC TELEPHONE SYSTEM.

The question of municipal ownership of telephone systems is at present receiving much consideration. There seems to be a growing tendency, especially in rural districts and small towns, to form local telephone companies for the purpose of furnishing telephonic communication in the immediate vicinity as well as with adjacent villages and outlying districts. Many of these exchanges are now in successful operation, especially throughout the province of Quebec and the Maritime Provinces.

The town of Neepawa, Man., is one of the few corporations in western Canada which has shown its faith in municipal ownership of telephones. The authorities there have recently purchased from Messrs. Ness, McLaren & Bate, the well-known manufacturers of telephones and electrical supplies of Montreal, a complete outfit, consisting of a central exchange switch-board, with a capacity for 150 subscribers, and 150 long distance telephones, all supplied and installed by the above firm. An illustration of the switchboard in actual use is shown on this page. This type of board is recognized throughout Canada as the standard instrument. The drop used is very neat and occupies little room ; the jack being placed immediately under the drop permits of making up the switchboard with a capacity for a large number of connections in a comparatively small space. The latest styles of exchange connections are used, such as cam levers and push buttons for generator, separate "ring off" drops, head receiver for operator when required, and also a special attachment for night alarm, the drop in falling making connection with a local battery and bell which continues ringing until the drop is reset. Connections with subscribers' lines are all made at the rear of the board in a convenient manner, each line being attached to a binding post on a numbered strip so as to be easily available for reference.



SWITCHBOARD IN TELEPHONE EXCHANGE AT NEEPAWA, MAN.
(Installed by Messrs. Ness, McLaren & Bate.)

Aerial lead encased cable is generally used for connecting the switchboard with the line wires of subscribers, the distributing cable box being placed on the nearest pole and connections made there when plant is installed. Each telephone may be grounded separately or a metallic return used by having a special switch-board suited for the purpose. The latter, however, costs double the amount of the former.

That the system installed at Neepawa has given eminent satisfaction is shown by a letter received recently from the authorities. Writing on their behalf, Mr. J. W. Pattison, secretary-treasurer of the municipality, says that "While at first you made up for us and installed only 100 of your Milde long distance telephones, we have since had to order from you several additional lots of instruments, the number of subscribers having increased until we have now our full complement. The system is giving perfect satisfaction."

The independent telephone idea appears to be growing. In Sweden the telephone system is under state control, and it is said that there are more telephones in use in that country than anywhere else in the world. Throughout the United States it has already assumed large proportions.

# ELECTRIC RAILWAY DEPARTMENT.

## PROPOSED ELECTRIC RADIAL RAILWAYS.

For some time a system of electric railways radiating from the city of Toronto, and passing through the somewhat thickly settled districts of Central Ontario, has been agitated. The City Council of Toronto instructed the Committee on Works to submit a report on such a system. This was done by Ald. Lamb, as Chairman of that Committee, in May last. A careful study of the question was made by Ald. Lamb, who outlined a scheme the execution of which, he believes, will result in a great expansion of the trade of Toronto and be of great benefit to the city and surrounding districts.

The proposed system consists of six main lines, with four branches, the route of which is shown by the accompanying map. The total mileage of the proposed system is 354 miles. The City Engineer of Toronto estimates that the cost of constructing the system would be approximately $5,000,000, made up of $2,850,000 for construction of tracks, grading, bridging, etc., and $2,150,000 for overhead work, power houses, machinery, car barns, equipment, etc. The cost of supplying power, the engineer states, will depend largely upon the amount of water power available along the different routes, and also as to the feasibility of transmitting power from the Niagara Peninsula.

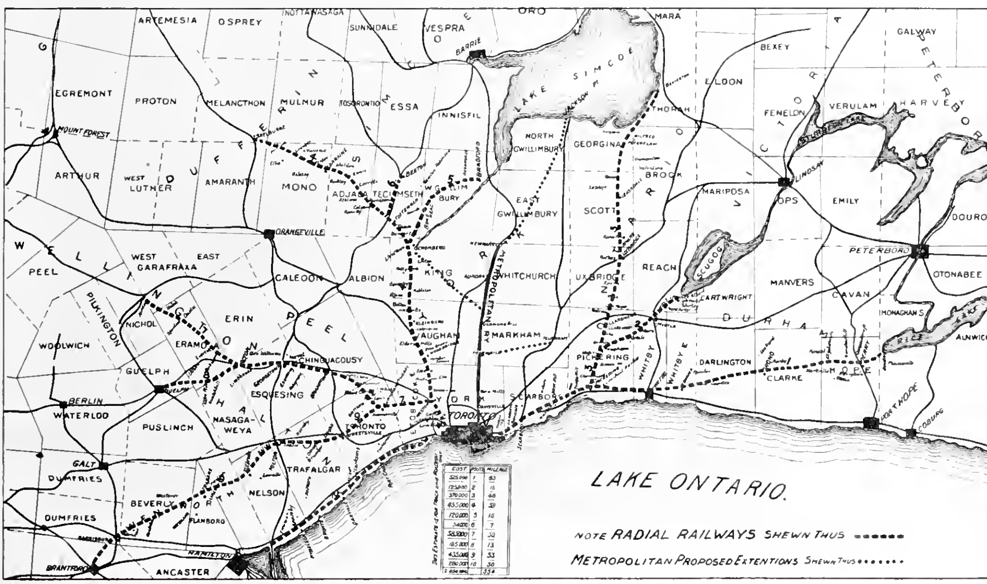
The assessed value of the city of Toronto is $125,736,000, and that of the townships through which it is proposed to extend the radial system $91,578,618, making a total assessed value of $217,314,618. The population of Toronto is 225,000, and of the townships 187,834.

The following propositions for building the system have been made by Ald. Lamb :

1. That the city of Toronto, together with the townships to be benefitted, could jointly build and equip the entire system at a cost of $5,000,000 by the issue of bonds bearing interest at 3 per cent., said bonds to be guaranteed by the respective municipalities in the proportion of their assessed values. The total value of bonds would be equal to a guaranteed assessment of 2½ per cent. upon the respective assessed value of each municipality. The interest of such guaranteed bonds would be the first charge upon the earned profits, so that in all probability there would be no expense incurred to the different municipalities except the liability of a guarantee.

2. The city and townships could contain control of the system as a public franchise by constructing the tracks, bridges, etc., at a cost of $2,850,000, under the same financial basis as above, and inviting tenders under certain terms and condtitions for operating the road, the contractor supplying all overhead work, electric plant, cars, etc., and the guaranteed interest upon the municipal bonds to be the first charge.

3. The city of Toronto, the counties or townships to combine for the purpose of advertising for tenders for the exclusive privilege of constructing and operating the proposed railways.



Proposed System of Electric Radial Railways from Toronto.

A further step has just been taken by Ald. Lamb, who is having prepared an act to incorporate the Toronto and Central Ontario Electric Radial Railways, with a capital of $5,000,000, to construct and operate the system in conjunction with the different municipalities. He is said to have received positive assurance that such a company could be financed in New York city, but Canadian capitalists will be given the preference.

The routes as suggested on the map are not final, but may be changed to others more advantageous or to suit the financial support given by such townships as may wish to avail themselves of the system. An adjunct to the scheme is the extension of the Metropolitan electric railway from Thornhill east to Markham, from the main line just north of Richmond Hill west to Schomberg, and from Newmarket north to Jackson's Point.

The construction of such a system of electric railways could not but prove of great benefit to the country districts. It would increase the value of the farms in the several localities and provide the farmer with an easy means of getting his produce to market. In the United States similar systems are said to be operated with success and as a profitable investment to the promoters

# ENGINEERING and MECHANICS

## BANQUET OF STATIONARY ENGINEERS.

The annual banquet of Toronto No. 1, Canadian Association of Stationary Engineers, will take place at the Walker House, Toronto, on Thanksgiving eve., October 17th. Such arrangements have been made as ensure an evening of pleasure. The local committee is composed of Messrs. G. C. Mooring, president; J. W. Marr, secretary; W. L. Outhwaite, treasurer; W. J. Webb, A. M. Wickens, H. E. Terry, S. Thompson, John Fox, A. Storer and Jas. Bannon. The tickets are one dollar, and may be obtained from any member of the committee.

## CHIMNEY CONSTRUCTION.*

By E. J. Philip.

THE construction of chimneys does not give us much thought, like many other things we have to deal with, until we have to construct one, and when you begin to look up facts it will surprise you how little real information there is to be had on the subject.

In the old country, where there are many large chimneys used for all purposes, there is on record much information both in reference to building, straightening and taking down. Most of the very high chimneys are used for other purposes than producing draft to burn coal, such as carrying off the poisonous gases from chemical works, etc. There is a book published called "Tall Chimney Construction," which gives the general details of many stacks built in the old country, and from these records you can make formula to guide you in designing a new stack.

Let us consider what is the proper method of designing a chimney for any given purpose. The first question is, "What is the chimney for, or what is it to do?" for this will govern some details of the shell. For instance, if it is to produce draft for ventilation, it will not require to be lined with fire-brick, nor will there be any benefit in putting in a loose lining.

We will suppose the chimney under our consideration is to induce draft to burn coal, as that is the most likely duty of any chimney that we will be connected with.

The size of the flue is the first dimension you will require, and it will depend on the quantity of coal to be burned and the velocity of the gases up the shaft. It is easily understood that as chimney powers increase the dimensions do not increase proportionately. To illustrate this I will take some figures from a table in a reliable work:

A chimney 70 ft. high, 30" diameter = 100 h.p.
" " 200 ft. " 66 in. " = 1000 h.p.

That is, the high chimney with five times the area equals ten times the power; and while I am not sure that this proportion is right, it seems to illustrate the way the formula works. The only correct way is to calculate the number of cubic feet of gas going up the chimney at the average velocity, and the area of this column is the area of the chimney. The rate of combustion depends on the draft, and the draft depends on the height of the chimney and the temperature of the gases. The height of the stack is nearly always determined by the surroundings, as the stack must of necessity be above any buildings or hills, and I might say that the average stack is higher than is necessary. However, when there are no buildings or hills, the following formula will establish the height. This is known as Gale's formula:

$$=H\frac{120}{T}\left(\frac{F}{g}\right)^2$$

After getting the height, the area may be obtained by Kent's formula, which is: $A=\frac{.06F}{\sqrt{H}}$ In this rule the effective area is obtained and is two inches less all round than the actual area. This two inches is to make up the friction of shaft. We now have area of chimney and height of it. I might say that experience has shown that to burn hard screenings requires 175 feet stack, for buckwheat 150 feet, and for soft coal 80 to 100 feet. This is a pretty fair basis to start from. We will suppose our chimney is, say, 100 feet high and 40 square feet area. It looks a simple matter to construct a stack having this information, and so it is, only you must go about it in the right way. To continue your calculations after getting the size, you start at the top and work down. Authorities say that a chimney having a flue over five feet in diameter shall be 1½ brick thick at the top; from three to five feet in diameter, one brick; and under three feet, half a brick. A chimney five feet or over would have this size for the first 25 feet down and would increase ½ brick for each 25 feet. This, according to calculations, is almost too much. It can run 30 to 40 feet each stage, but will depend on kind of material, that is, whether hard or soft brick, and whether built in cement or lime; 30 to 40 feet will work with good material and workmanship. Having laid out the different thicknesses of wall, and knowing the batter, which varies with different builders and conditions from 1/16 to 3/8 of 1 inch, having this you can get the weight of shaft or chimney proper. In large chimneys it is usually specified what they shall weigh per cubic foot. After getting weight you can decide how much bearing surface you will require for the kind of soil you have at the foundation. Various bearing powers of soil are given as follows: Hard rock, native bed, 100 tons sq. foot; clay, dry, 4 to 6; moderate dry, 2 to 4; soft, 1 to 2; gravel and coarse sand, 8 to 10; sand compact and well cemented, 4 to 6; clean dry sand, 2 to 4; quicksand and alluvial soils, to 1 ton per square foot.

When the ground is soft you would require piling or timbering, and to spread it out over a considerable surface. The weight in tons divided by bearing power of soil gives surface required. Wind pressure is also an important factor in getting the area of the base. I will not go into the rules affecting wind pressure, but experience has shown that at the base of shaft proper its diameter shall be 1/10th of height for square chimney, 1/11 for octagon, and 1/12 for round. In considering wind pressure it is usually figured at from 25 to 56 lbs., by different authorities. This must be resisted by foundation, as you can see that if the chimney rocks over with wind it will throw its entire weight on one side of foundation. In considering wind pressure it is necessary to take into account whether chimney is protected by buildings or standing in an open field. If the chimney is built into a building, windage may be almost disregarded except for piece above the roof.

There has been a great deal written and many discussions as to the merits of different shaped flues, but experience and tests have shown that a parallel flue is the best or as good as any shape. The arguments for taper flues are something like this, that the gases slow down due to cooling as they go up, and consequently they require more room, and the flue should get larger; others say that the gases cooling down contract in volume, and therefore the flue should get smaller so as to take the same shape as the column of gas. Experience has shown that both are correct. The gases contract and get smaller and consequently need less room, but they also slow down in velocity, due to their greater weight and therefore need more room. In this way they just balance up and require a parallel flue. Authorities say a round parallel flue is the best for all purposes, and the nearest approach is the next best.

The chimney should be finished with a cap of some material that will stand the weather. I like cast iron best, but a cap can be moulded of Portland cement, and if the stack is for smelting work, of fire clay. These materials stand well, and if there is a ladder on the chimney they can be kept in repair. A ladder should always be built on the shaft, as it makes a means of examining it at any time, and if repairs are needed they can be done easily.

Lightning conductors are also approved and disapproved; but if a chimney is the highest object in its vicinity it is likely to take the discharge from a storm over it, and a properly erected conductor will carry it off, although many stacks are standing without any.

* Paper read before the Canadian Association of Stationary Engineers.

The Cayuga Electric Light Company, of Cayuga, Ont., recently suffered the loss of their electric light plant by fire.

The electrical kitchen is a feature of the Paris Exposition, it being probably the most elaborate affair of its kind ever installed. Between three hundred and four hundred guests have been cared for daily. The mean consumption of electricity amounts to about six cents per guest per day. The main advantage with the electric kitchen is the rapidity with which food can be cooked and the absence of smoke and all possible danger of fire.

## ENGINE ROOM NOTES.

W. H. WAKEMAN, in the Wood-Worker.

It is always a good plan to watch an engine carefully for loose pins, setscrews and nuts, for an ounce of prevention of accidents in this way is worth several pounds of cure, after an engine is wrecked by the failure of a governor to do its duty.

Grate bars should fit the furnace so as to prevent waste of fuel; but they should not be wedged in so tightly that when they are expanded by heat they will be ruined.

Friction clutches and cut-off couplings are a great convenience in a mill or factory; they enable the operatives to quickly stop a line of shafting in case an accident happens, without waiting to get word to the engineer. They also save power by making it convenient, or possible, to allow one or more lines of shafting to remain at rest, when not needed for use.

When selecting hangers, choose those which will admit of taking out the shafting without removing the bolts holding the hangers; in case of repairs it may save much time and expense.

When laying out holes in belts for lacing, do not locate them so near together that the strength of the belt will be seriously impaired; and after you have laced it, draw in extra pieces of lacing so that they will come between belt and pulley when in use, as they will save the lacing that holds the belt together.

It is poor policy to allow any kind of packing to remain in use too long, and especially so in the case of valve stems on Corliss engines, which are often made of a composition that is easily cut and grooved.

When an injector has worked well for some time, then declines further service, examine the feed pipe to boiler and see if it has become choked with scale and sediment.

It is a good plan to use a little oil on asbestos wicking, when packing valve stems, but if much is put on it makes an unsightly mess on the bonnets of nick'e-plated radiator valves and in other similar places.

It is very annoying to an engineer who understands his business, to find that as soon as the flywheel begins to revolve in the morning, or when starting up after dinner, some workman in the shop has started a heavy machine into operation. As a rule these machines do not turn out good work when running at a slow speed; but whether they do or not, they should never be started until the engine has attained its full speed. Machinery in silk mills and similar places are exceptions to this rule, but wood-working machinery is not.

Metallic piston rod packing is a very good thing to have, but some kinds are made in the form of a wedge, and if an engineer screws the nuts on the studs up tightly, he may get himself into trouble; therefore he should go slowly until he fully understands the construction of the packing in his stuffing box.

If the indicator diagram from your engine shows an imperfection for which you cannot account, be sure that the indicator piston is well oiled before losing sleep to worry over it, for the oil may change the whole aspect of affairs.

Boiler compounds are necessary in many cases, but as soon as scale is removed from the shell and tubes, it should be taken out without delay, as it may cause the crown sheet to be burned.

Flange unions in the main steam pipe between the lubricator and the cylinder should be packed with asbestos millboard, copper gaskets, or some other substance that hot oil will not dissolve.

Where a jet condenser is in use, some of the exhaust steam will find its way back into the boiler, after being condensed and passing to the hot well; therefore measures should be taken to remove cylinder oil from it before it is condensed.

If the main belt on your engine has run steadily for years or months, and then begins to "flop" in an unreasonable manner, do not hasten to saw a piece out of the floor through which it runs, nor yet to cut a piece out of the belt, but apply an indicator and see if the valves do not need resetting.

Every pound of back pressure on the piston of an engine means another pound of forward pressure, which in turn means more fuel for the boiler, hence the back pressure should be reduced to the lowest point possible. This is what a condenser is used for.

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At the time of going to press the tenders received for electric light and power plant for the corporation of Morrisburg, Ont., have not been made public.

## SPARKS.

The Royal Electric Company are said to have decided to close down the electric plant at Aurora, Ont.

Mr. S. Glass, chief engineer of the Victoria Hospital, London, has recommended that a third boiler be put in.

The Cataract Power Company, of Hamilton, have put in a new 3,000 horse power turbine at their DeCew Falls power house.

Reeve Savage, of Richmond Hill, Ont., will submit to the council of that village a proposition for a system of municipal electric lighting.

Mr. Roderick J. Parke, E.E., of Toronto, has been advised by the town council of Perth, Ont., of his appointment as valuator for the town.

The Water Committee of the Montreal City Council has decided to call for tenders for the proposed electric motor plant for the high level reservoir.

The ratepayers of Almonte, Ont., will vote on a by-law on October 20th to raise $30,000 by the issue of debentures to establish an electric light plant.

There is a deadlock between Messrs. Eager & Sanderson and the village council of Winchester, Ont., over the price for electric lighting. If an agreement is not reached the lights may be discontinued.

The Berlin Furniture Co., Berlin, Ont., have placed an order with The Electrical Construction Company, of London, Limited, for a 150 light multipolar dynamo to be installed in their new factory.

Col. Tracey, of Vancouver, has estimated the value of the property of the Revelstoke Water, Power & Light Company, of Revelstoke, B.C., at $69,970. The company asks for the property $76,775.

The tender of the Goldie & McCulloch Company, of Galt, for an engine and boiler for the Newmarket electric light plant, has been accepted. Plans for an addition to the power house have been made.

Adelard Bolduc, of Hull, is issuing the Hull Electric Company for $10,000 for the death of his son, who was killed by an electric car. The plaintiff claims that the car was running at a high rate of speed and was not provided with a fender.

The Electrical Construction Company, of London, Limited, have secured the contract for the supply of a 600 light generator, and for the complete wiring of the new buildings of the McLaughlin Carriage Co., Oshawa, Ont.

The Standard Light & Power Company, of Montreal, have elected directors as follows: President, W. McLea Walbank; vice president, J. H. Burland; secretary, D. Craig; Peter Lyall, S. Finley, W. S. Evans, L. Henault and R. Wilson Smith.

Mr. E. B. Douglas, president of the Sault Ste. Marie Pulp & Paper Company, has placed before the councils of Fort William and Port Arthur, Ont., a proposition to supply these towns with electric light and power, developed from the Kakabeca Falls.

Negotiations are said to have been in progress for the purchase, by an American syndicate, of the plant of the Trenton Electric Company. The purpose of the syndicate is said to be to largely increase the present capacity of the plant. We have not learned that the purchase has yet been consummated.

The Brandon Electric Light Company, of Brandon, Man., are making good progress with the development of the power of the Little Saskatchewan river. The work of building the dam is nearing completion, and the power house has been commenced. It is probable that the town waterworks will be operated by electricity.

The Parry Sound Electric Light Co. are remodelling their power house and putting in two new boilers and one new engine, manufactured by the Waterous Engine Co., of Brantford, and one 75 k.w. monocyclic generator. The plant, when fully equipped, will consist of three water-wheels, two monocyclic generators of 75 k.w. each, and an auxiliary steam plant of 150 h.p.

The incandescent oil lamp invented by Mr. V. L. Emerson, of Ottawa, was recently given a test in that city. Six 16 candle power electric lights, we are told, illuminated the room in which the party of witnesses sat, and one student lamp, the globe of which was of about the size and appearance of the ordinary auer burner, was placed on the table. This light was constantly turned on and off to show the contrast between the six 16 candle-power electric lights and the new invention, and it is reported that the difference in brilliancy was remarkable.

## DYNAMO PLANT FOR TELEGRAPH WORK.

The C. P. R. Telegraph Company have installed a plant of motor generators in their Toronto office, to supply current to their circuits. The plant is located in the old battery room, which formerly was filled with battery stands supporting some two thousand cells, all of which have been done away with—the dynamo room now occupying about one-quarter of the space which had been taken up with battery jars. The machines consist of twelve Lundell motor generators, manufactured by the Sprague Electric Company, resting on two heavy wooden stringers raised 30 inches above the floor. Connection is made by means of twelve 5-conductor cables (one cable to each machine) with the switchboard, consisting of a slab of slate on which are muonted the necessary switches. The switchboard is bolted to a framework of angle iron secured to the floor and ceiling. On each side of the switchboard, mounted on wooden cross-bars bolted to the iron frame, are the rheostats, one for each machine; above the switchboard are the ammeter and voltmeter, of Weston make. The voltmeter is provided with a flexible conducting cord and wedge, by means of which the voltage of any circuit can be taken. By means of a double throw two pole main switch connection can be had with either the overhead or underground circuits of the Toronto Electric Light Co. In the circuit between the main switch and the motor switches is placed a reversing switch, which is used on occasions when service current happens to be reversed. In the main circuit there is also a regulating rheostat and an underload switch. On the upper part of the switchboard are located the secondary switches, by which connection is made with the cable leading to the operating room, where the secondary currents are distributed to the wires through lamp resistances. The machines are wound for 225 volts primary, the secondary ratings being as follows: One of 100 volts, 2.5 amperes; two of 30 volts, 34 amperes; three of 130 volts, 3 amperes; three of 200 volts, 2.5 amperes; and three of 400 volts, 2.5 amperes. It being necessary to run only seven machines constantly, one machine of each voltage is allowed to remain idle in reserve. The secondary switches are so arranged that the machines can be transposed without interruption to continuity of current supplied to operating room.

## PERSONAL.

Mr. Wm. Tarlin, late of Mitchell, Ont., has been appointed manager of the electric light plant at Palmerston, Ont.

Mr. Thos. Potter, who for eleven years past was superintendent of the Walkerton Light and Power Co., has recently resigned.

Mr. Walter Stillwell, head dynamo tender for the St. John Street Railway Company, has resigned, to accept a position in Sydney, C. B.

Mr. Andrew Ingram, of Seaforth, has removed to Kincardine, where he becomes superintendent of the electric light plant owned by the town.

It is announced that Mr. W. E. Gower, C. E., of Montreal, will in future reside in Great Britain as the representative there of the American Stoker Company.

The Electrical News recently had the pleasure of a call from Mr. Harvey Hubbell, an extensive manufacturer of brass machinery screws, of Bridgeport, Conn.

Mr. Geo. Patterson has resigned the management of the Amherst Electric Light Company, of Amherst, N. S., and purposes spending the winter at his home in Truro to recuperate his health.

Mr. G. F. MacDonald, city electrician of Ottawa, Ont., attended the recent convention of the Association of Municipal Electricians held in Pittsburg, Pa. Mr. MacDonald was honored by being re-elected vice-president of the association.

It is with pleasure that we notice that Mr. P. McCullough, late chief electrician for the Toronto Railway Company, who went to England a few months ago, has been appointed assistant manager of the municipal tramway system at Liverpool, England.

Mr. L. W. Gill, B. A. Sc., of Montreal, has been appointed lecturer in the newly appointed chair of electrical and mechanical engineering in the Kingston School of Mining. Mr. Gill is a gold medalist of McGill and will no doubt fill his appointment in an acceptable manner.

Mr. E. J. Philip, who for a number of years has been chief engineer for the T. Eaton Company, Toronto, has tendered his resignation. Besides having the surpervision of the large electrical and steam plant, Mr. Philip acted as mechanical superintendent of the entire establishment.

Mr. Ralph D. Marchand, who for some years was expert for the Westinghouse Electric and Manufacturing Company in connection with the long distance transmission of electricity, is reported to have accepted a similar appointment with the Montreal Street Railway Company and the Chambly Manufacturing Company.

## SPARKS.

The talk of an electric railway from Yarmouth to Digby, N.S., has been revived.

Mr. Edmund Conway, of the Quebec Railway, Light & Power Company, has been granted a patent on a street car fender.

Judge McDougall has been named as arbitrator in connection with the purchase of the electric light plant by the town of Woodstock, Ont.

The annual meeting of the Merchants Telephone Company, of Montreal, was held in that city a few days ago. The directors were re-elected.

A syndicate is negotiating for the purchase of Lake Park from Mr P. P. Salter, with a view to improving the park and building an electric railway to Carleton Place.

The Goderich Engine and Bicycle Company are now manufacturing the Whiting automatic pump, having acquired the exclusive right to manufacture this pump in Canada.

Mr. John Patterson, secretary of the Cataract Power Company, Hamilton, has made application to the township councils of Barton, Saltfleet and Grimsby for right of way for an electric railway. The line may be built next spring.

The Sarnia Street Railway Company are asking for tenders for ties, poles and overhead construction in connection with the conversion of the street railway at Sarnia, Ont., to an electric system.

The Cataract Power Company and other Hamilton capitalists have formed the Patterson Coal & Coke Company, of Pennsylvania. A large tract of coal lands in the Pennsylvania district has been acquired, and it is the intention to bring soft coal to Hamilton and establish large coke ovens adjoining the city.

The street railway of St. Thomas, Ont., has passed into the control of a new directorate, of which Mr. E. H. Coughall and Mr. J. W. Moyes, the latter of the Metropolitan Railway, of Toronto, are members. It is said that the road will be extended to Port Stanley. The company have already running privileges in Yarmouth and Southwold. Mr. E. H. Coughall will become manager.

The Niagara, St. Catharines & Toronto Railway Company have been granted, by the Stamford township council, an extension of time to May, 1901, to complete the Niagara Falls, Wesley Park & Clifton Electric Railway on Murray street. Mr. Edward Baxter and others have applied to the township councils for a franchise to build an electric railway from Chippewa to Falls View, Ont. Attorney O'Brien, of Buffalo, is looking after the charter.

The nineteenth annual convention of the American Street Railway Association will be held at Kansas City, commencing on October 6th. Papers on the following subjects will be read: "Double Truck Cars; How to Equip Them to Obtain Maximum Efficiency Under Varying Conditions."; "Comparisons of the Various Systems of Electrical Distribution for Street Railways"; "Consolidation of Street Railways and Its Effect Upon the Public"; "The Store Room and Store Room Accounts" "Painting, Repainting and Maintenance of Car Bodies."

The Sarnia Electric Light & Gas Company have just reconstructed their plant, which now consists of two boilers, two engines, one alternator and one arc machine. The smaller engine is a single cylinder of 100 h. p., and the large one a tandem compound of 250 h. p., both of the automatic cut off Wheelock type, and belted to a new shaft, arranged with friction clutches in such a manner that either engine or machine can be used, or both. The main driving belt is 26 inches in width and 90 feet long. There is a duplex condenser, manufactured by the Northey Company, of Toronto. The alternator is a T. H. machine of 1000 lights capacity, and the arc machine is of the Wood system, capable of supplying 75 1,200 c. p. lamps. Both machines were supplied by the Canadian General Electric Company, of Toronto. The work of construction was carried out under the supervision of Mr. Wm. Williams, manager and secretary of the company. Mr. Geo. Shand is engineer in charge.

## SPARKS.

A Detroit electrical firm has secured the contract for wiring for electric light the House of Refuge at Leamington, Ont.

The Elmvale Electric Light Co., Elmvale, Ont., have just installed a steam heater, supplied by H. W. Petrie, of Toronto, and a steam pump.

The tender of the Goldie & McCulloch Company, of Galt, has been accepted by the council of St. Mary's, Ont., for furnishing engines, boilers, etc., for the electric light plant. Elliott & Clyde will build the power house.

The Wolfville Electric Light & Heat Company, of Wolfville, N. S., have purchased water power privileges on the Gaspereau river from Mr. S. P. Benjamin. The extent of land involved is 30,000 acres and the consideration $30,000.

The town of Cayuga, Ont., is about to install an electric plant to supply private and street lighting, the plant there having been recently destroyed by fire. Mr. H. F. Strickland, E. E., of Toronto, is acting as consulting engineer for the corporation.

The by-law to borrow $10,000 to extend he electric light and water works plants owned by the corporation of Newmarket, Ont., has received the sanction of the Lieutenant Governor of Ontario. This will remove the necessity of submitting the by-law to the ratepayers.

Mr. L. J. Marien, superintendent of the Montreal waterworks system, has made a report to the city council on the question of increasing the water supply. He recommends that the sum of $30,000 be appropriated for the purpose of installing two electric pumps and the necessary motors at the high level reservoir. He reports that the superiority of electricity over steam, as a motive power, results from the inconvenience connected with the use of coal, also that the saving effected by the use of electric power would very soon reimburse the capital invested.

## TRADE NOTES.

The Jackson Cochrane Co., Berlin, Ont., have purchased from the Electrical Construction Company, Limited, of London, one 75 light multipolar dynamo.

Messrs. Jack & Robertson, Montreal, Canadian agents for the Sprague Electric Company, have recently sent out to the trade Bulletin No. 200, descriptive of the Lundell motor equipments for printing establishments and book binderies, and Bulletin No. 400, relating to the Greenfield flexible steel armored conductors.

The Electrical Construction Company, of London, Limited, report the following sales during the past month: Ness, McLaren & Bate, Montreal, one 5 h.p. bipolar motor; Oram & Carter, Kingston, one 8 h.p. bipolar motor; L. Allcock, Sault Ste Marie, one 5 h.p. bipolar motor; The Rehder Plating & Mfg. Company, Thorold, Ont., one 12 h.p. motor; G. E. Matthews, Montreal, three machines of different sizes.

We are pleased to learn of the establishment of the Canadian Correspondence Schools of Toronto, the purpose of which is to carry on correspondence instruction by mail, after the manner of the correspondence schools in the United States. Among other subjects, the schools will have courses of instruction in electric lighting, electrical engineering, stationary steam engineering, and hydraulic engineering. Mr. A. J. Pell is manager and treasurer, and Mr. E. H. Richard superintendent of instruction.

In honor of the tenth or "tin" anniversary of the Canadian Electrical Association, Mr. E. E. Cary, one of the vice-presidents of the association and manager of the Packard Electric Comoany, of St. Catharines, is sending out a perpetual calendar, handsomely framed in aluminum, which is the nearest approach to permanent tin which could be found for the purpose. In addition to the calendar the frame bears on its face a thermometer, intended, we presume, as a reminder to business men to keep cool even at the expense of an electric fan.

The business of the Eugene F. Phillips Electrical Works, at Montreal, has so increased that the manufacturing capacity of the works has become altogether inadequate, and arrangements are being made to enlarge the factory. For many months past the works have been operated day and night. A number of improvements have been made in the plant, which have assisted the company in meeting the demands of customers. Among other large orders, the company have supplied bare copper wire to the value of about $40,000 for the Cataract Power Company's second transmission line between their generating station at DeCew Falls and Hamilton. The management of this rapidly growing industry is now in the hands of Mr. George H. Olney.

The Canadian Heine Boiler Company, of Toronto, are just installing two 410 h.p. Heine boilers in the T. Eaton Company's departmental store, in addition to five boilers of 150 h.p. each already installed. They are also installing two 410 h.p. boilers for the Toronto Electric Light Company, in addition to five of 250 h.p. each and two of 410 h.p. each previously used in operating that company's plant. This makes a total capacity of 3,960 h.p. in Heine boilers installed in these two establishments. The Canadian Heine Boiler Company are also putting in a 150 h.p. boiler for the Toronto Biscuit Company, and two 250 h.p. boilers for the Gutta Percha & Rubber Company, who already have one of similar capacity in use. They have just completed, and started in successful operation, two boilers of 250 h.p. in Lever Bros.' soap works.

## SPARKS.

Mr. W. C. Caldwell has purchased a dynamo of 500 lights for lighting his mill at Lanark, Ont.

The council of Hespeler, Ont., want an engineer to take charge of the municipal electric plant.

The new pole line of the Cataract Power Company, from the power house at DeCew Falls to Hamilton, is about completed.

The Electrical Construction Company of London, Limited, have received orders from their Winnipeg agents for one 15 h.p. multipolar motor, one 16 h.p. multipolar motor, and one 8 h.p. bipolar motor.

The present contract for lighting the streets of the city of Montreal will expire on December 31, 1903. Ald. Ames moved in council that the Fire Committee be instructed to prepare specifications within ninety days in order to call for tenders for lighting the city after the above date. He pointed out that a new company would require two years in which to install the necessary plant. The motion carried.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. NOVEMBER, 1900 No. 11.

## THE SARNIA GAS AND ELECTRIC LIGHT COMPANY.

As mentioned in last issue, the plant of the Sarnia Gas & Electric Light Company, at Sarnia, Ont., has been reconstructed, and modern apparatus installed. A view of the plant as rebuilt is shown on this page.

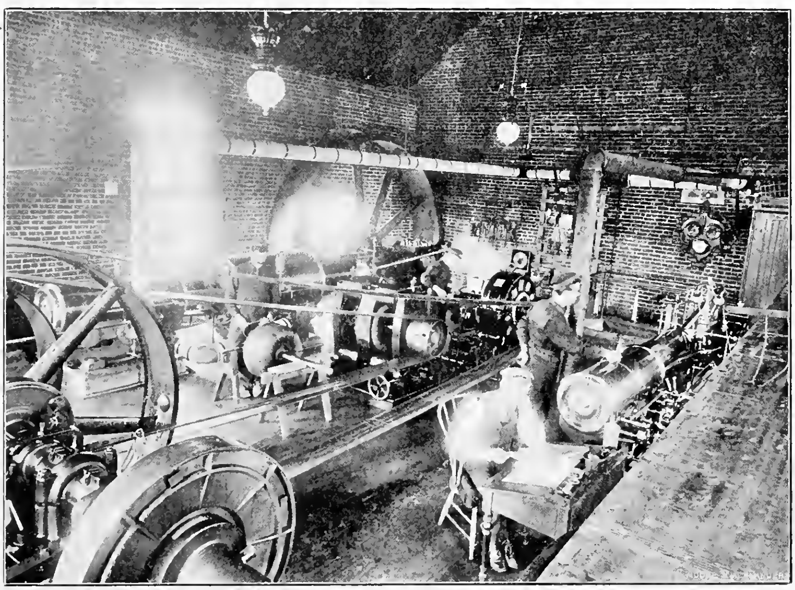
The power house is of red brick, with freestone trimmings and stone foundation. It has a truss roof, and is covered with iron, making the building practically fire-proof.

The power equipment of the plant now consists of two large boilers and two engines of the automatic cut-off Wheelock type. The smaller engine is a single cylinder of 100 h.p., and has been in use for some time. The new engine is a tandem compound of 250 h.p. capacity. Both are belted to a new shaft arranged with friction clutches in such a manner that either engine or machine may be used, or both. The main driving belt is 26 inches in width and 90 feet in length. There is a duplex condenser furnished by the Northey Manufacturing Company, of Toronto.

The electrical equipment includes a T.H. alternator of 1,000 lights capacity, and a Wood arc machine capable of supplying seventy-five 1,000 c.p. lamps, both being supplied by the Canadian General Electric Company.

The boilers, engines, shafting, pulleys and clutches were supplied by the Goldie & McCulloch Company, Limited, of Galt, Ont., and were installed by Mr. L. Ingall, erecting engineer for the company. The plans and specifications of the foundations for the machinery were prepared by Mr. R. W. Fawcett, of Sarnia, while the entire work of reconstruction was carried out under the supervision of Mr. Wm. Williams, manager and secretary of the company. The operation of the plant is in charge of Mr. Geo. Shand, chief engineer, and a staff of able assistants.

In addition to their electric lighting business, the Sarnia Gas & Electric Light Company will also supply the power for the new electric street railway now in course of construction in that town. The plant of the company as remodelled is modern and up-to-date in every respect, and should prove a profitable investment for its owners.



INTERIOR OF POWER HOUSE, SARNIA GAS AND ELECTRIC LIGHT COMPANY, SARNIA, ONT.

The St. George & Penfield Telephone Company have elected M. Eldridge president, H. H. McLean vice-president, and E. W. Cross secretary-treasurer.

In connection with the proposal for municipal control of the electric light plant at Kingston, Ont., the utilization of the water power of some of the falls adjacent to Kingston is spoken of. At Kingston Mills 400 horse power is said to be available, and at Jones Falls about 1,000 horse power.

## QUESTIONS AND ANSWERS

"Reader" asks: Are both the motors in a street car always in use when the car is moving, where series parallel controllers are used.

Ans.—Yes, both motors are in use for practically all the time that the controller is turned on, the only exception being the few seconds during which the connection is being changed from series to parallel. The current, when the motors are in series, goes first through No. 1 motor, and then through No. 2, thus the same identical current goes through both motors; when the controller is put on to any of the parallel positions, separate currents go through each motor, though if the motors are similar, and neither pair of wheels slip, the currents will be about equal.

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"J. B.," Montreal, writes: I have two direct current dynamos running in parallel, driven by separate engines in different rooms; is there any danger of one of them reversing and damaging the work going on through some other machines which are driven by the same countershaft?

Ans.—We presume that you mean in case either engine belt come off or anything go wrong with either engine which would cut off the steam from it, to which we would answer no; there is not the slightest danger. If by any accident the power driving either dynamo should come off, it would still continue to run as a motor, and to revolve in the same direction.

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"Superintedent" writes: We are having a good deal of trouble in our pattern shop with our incandescent lamps burning out, though lots of lamps are running for over one thousand hours on other lines in the machine shop, offices, etc. I have tested all over, but cannot find anything wrong. What would you suggest?

Ans.—Your trouble is proabably due to static electricity, which generally gives most trouble in rooms where there are many high speed belts running and much dust flying. If static electricity is the cause, you will find a very fine star shape crack towards the bottom of the bulb, which is caused by the hot filament (which is attracted by the static charge in the glass) striking the glass and cracking it. The vacuum is thus destroyed, and the air gets into the bulb and instantly burns the filament. The remedy is the use of lower efficiency, slightly higher voltage and higher candle power lamps.

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"C. B.", Halifax, writes: I have two lines of shafting to be driven from one electric motor. Can I run two belts off of it, or will I have to belt from one line of shafting to another?

Ans.—If you have room to put your motor between the two lines, it would be best to belt direct from it to each line, the belts driving each way from a special pulley having two crowns. This method has the advantage over the one in which a pulley is used at each end of the motor, of reducing the strains on the bearings and frame, and also of giving freer access to the motor for inspection and cleaning.

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"Engineer" says: We are putting in a new engine in our mill, for which we will have to get a new belt about fifty feet long. As I want to get the very best service possible out of it, please advise me which side I should put next the pulley.

Ans.—If your belt is to be single, you should run the flesh or grain side out, because the outside of the belt when passing around the pulleys is subject to more or less of an extension strain, over and above the strain due only to the load it is driving; whereas the inside of the belt as it goes over the pulley is to a certain extent compressed; obviously, the flesh side being of a more soft and pliable nature than the hair side, is more suited to take the extension strain. If the belt is double, both sides will be grain, the hair sides being glued together, so you will have no choice in the matter.

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"Subscriber," London, wishes to know why it is that persons handling a secondary line (sockets) receive severe shocks, apparently primary effects, although it is impossible to find any trace of contact between primary and secondary or secondary and ground by means of 50,000 ohm well.

Ans.—The effect spoken of is due to either: (a) The normal secondary voltage; (b) an abnormal foreign voltage, which latter again may be due to: (c) Static charges, or, (d) a cross with a foreign circuit. (a) It must be remembered that voltages as low as 52 will often give severe shocks to certain nervous systems if their connection with the ground be good, though if all who handle the sockets experience the same effects it would seem to indicate that this is not the cause of the trouble. (b) If there are no belts in the room it is safe to say that this is not the cause. (c) If you are crossed with a line carrying a voltage higher than that of the secondary, it will most probably be a connection with the primary, in the transformer itself, though it must be borne in mind that any test to discover the fault should be made while the transformer is hot, as the cross may disappear as the apparatus cools. It may also be that you have a connection with arc or railway lines from some other generator which is "swinging," i.e., the lines are being blown or knocked together at intervals by wind or some moving object. We would suggest that you put a volt-meter between the socket and ground. If it show a voltage higher than that of the secondary circuit, and steady, you may be certain that your cross is either in the transformer or else in the wiring of that particular building, and should be easily discovered by a visual inspection. If the volt-meter reading is unsteady your cross is swinging, and as the secondary system is not likely to extend far from the building it should not be hard to find. If the foregoing does not serve to get you over the difficulty, if you will write more fully we will be able to go more in detail into the question.

### PUBLICATIONS.

The third edition of "Alternating Current Phenomena," by Chas. Proteus Steinmetz, has just been issued by the Electrical World and Engineer, of New York. This work is intended as an exposition of the methods which have been found useful in the theoretical investigation and calculation of the manifold phenomena taking place in alternating current circuits, and of their application to alternating current apparatus. In the third edition several new chapters have been added, such as those on vector representation of double frequency quantities as power and torque, and on symbolic representation of general alternating waves. Many chapters have also been revised. The new edition contains upwards of five hundred pages, is amply illustrated, and sells at four dollars.

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On October 17th the Mayor of Brockville, Ont., on behalf of the town, formally took over the electric and gas plants.

## A SUCCESSFUL METHOD OF LIGHTNING PROTECTION.

READERS of the ELECTRICAL NEWS will be interested in particulars of the somewhat remarkable experience of the Royal Electric Company of Montreal in connection with means adopted to protect from lightning their long distance transmission lines between Chambly and Montreal. These lines are about 17 miles in length each, of which 14½ miles is aerial, the remaining 2½ miles being composed of three sections of cable : the first section being about a mile and a half from the power house, the second section 15 miles from the power house, and the third section leading into the sub-station in Montreal.

Simultaneonsly with the construction of the pole lines, the company strung three barb wires to protect the transmission wires from lightning. This barbed wire lightning protection consists of three double strand No. 12 wire, with four barbs about every five inches apart. One of the three wires is placed on a pin, and a glass insulator on the top of the poles, the remaining wires are placed on ordinary glass pony insulators on the ends of the top cross-arm. Each of these wires are connected by means of a soldered joint to the ground wire running down the pole, this ground wire running through a one inch wrought iron pipe 8 ft. in length to the bottom of the pole, and after passing through the pipe, wrapped several times around the butt of the pole. The ground wire and pipe were placed on the pole at the time the poles were erected. The poles are 90 ft. apart and the barbed wires are connected to a ground wire on each pole. The grounding of the barbed wire every 90 ft. is considered one of the most important points in the protection.

It was originally intended to protect these transmission lines by means of banks of lightning arresters, but the lines were put into use before the company were able to procure the requisite number of lightning arresters. It was intended in the event of a severe storm to disconnect the lines until such time as the storm was over, in the meantime operating from the local station in Montreal, it being considered unwise to expose the transmission lines and cables and generators connected thereto to any possible destructive effect from lightning discharges from the transmission lines.

The first storm occurred about midnight, when it was practically impossible to transfer the system, and the company was apprehensive that the cables or step-down transformers or generators connected to the transmission lines might be punctured by destructive discharge. However, the storm passed, without any damage being done to the transmission lines. This seemed to indicate that barbed wire was very good protective device, and when the next storm occurred it was thought advisable to risk possible damage from lightning, inasmuch as the lightning arresters were not then procurable.

Time passed, and the entire summer with the numerous severe storms, had gone before the lightning arresters were available. By that time it had been conclusively proved to the satisfaction of the management that the barbed wire was an effective and efficient lightning protection. Since that time it has been entirely relied upon to protect lines in lightning storms. As an extra precaution, however one bank of lightning arresters was placed at the power house, but they are not regarded as necessary.

One particularly severe storm which occurred caused a great deal of damage to the company's property in Montreal. Noticing that the storm was travelling directly towards Chambly, the general superintendent put himself in communication with the power house by means of his private telephone and kept close track of the storm, which arrived at Chambly, 17 miles distant, about three-quarters of an hour after it had burst over Montreal. The company's lines and transformers in Montreal were considerably damaged, and two local distribution lines at the Chambly end were also damaged, but not a single discharge occurred on the two transmission lines, each 17 miles in length. During one entire season, without any lightning protection whatever with the exception of the barbed wire, there occurred no discharges from the 34 miles of transmission lines, although during the summer season there were numerous very severe thunder storms, which caused considerable damage on local lines that had not been protected by means of barbed wire. The barbed wire has been placed on glass insulators for the purpose of protecting it at the points where it is supported. One of the dangers to be apprehended from the use of barbed wire is its rusting and rubbing to such an extent that it becomes weak and breaks. The Royal Electric Company have not yet had a single barbed wire strand break, but they are giving this phase of the question considerable attention. The means sometimes employed for supporting barbed wire, that of connecting it to the top of the poles or cross-arms by means of staples, is thought to be productive of unsatisfactory results.

An exchange of opinions and experience by central station managers on this important subject would be welcomed by our readers, and is therefore invited.

### MOONLIGHT SCHEDULE FOR NOVEMBER.

| Day of Month. | Light. | Extinguish. | No. of Hours. |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | P.M. 11.50 | A.M. 5.30 | 5.40 |
| 3.... | A.M. 1.00 | " 5.30 | 4.30 |
| 4.... | " 2.00 | " 5.40 | 3.40 |
| 5.... | No Light. | No Light. | ... |
| 6.... | No Light. | No Light. | .... |
| 7.... | No Light. | No Light. | .... |
| 8. .. | No Light. | No Light. | .... |
| 9.... | P.M. 5.15 | P.M. 8.30 | 3.15 |
| 10.... | " 5.15 | " 9.30 | 4.15 |
| 11.... | " 5.15 | " 10.30 | 5.15 |
| 12.... | " 5.10 | " 11.30 | 6.20 |
| 13.... | " 5.10 | " 0.30 | 7.20 |
| 14.... | " 5.10 | A.M. 1.30 | 8.20 |
| 15.... | " 5.10 | " 2.30 | 9.20 |
| 16.... | " 5.10 | " 3.30 | 10.20 |
| 17 ... | " 5.10 | " 4.30 | 11.20 |
| 18.... | " 5.10 | " 5.30 | 12.20 |
| 19.... | " 5.10 | " 6.00 | 12.50 |
| 20.... | " 5.10 | " 6.00 | 12.50 |
| 21.... | " 5.00 | " 6.00 | 13.00 |
| 22.... | " 5.00 | " 6.00 | 13.00 |
| 23.... | " 5.00 | " 6.00 | 13.00 |
| 24.... | " 5.00 | " 6.00 | 13.00 |
| 25.... | " 6.00 | " 6.00 | 12.00 |
| 26.... | " 7.00 | " 6.00 | 11.00 |
| 27.... | " 8.30 | " 6.00 | 9.30 |
| 28.... | " 9.30 | " 6.10 | 8.40 |
| 29 ... | " 10.30 | " 6.10 | 7.40 |
| 30.... | " 11.40 | " 6.10 | 6.30 |

Total......... 224.55

The Bertram Engine Works, of Toronto, will install electric light plants on new boats now being built, and have given an order to the Canadian General Electric Company for two 25 k.w. direct connected direct current generators.

By a vote of 190 against 75 the ratepayers of Almonte, Ont., have just decided in favor of raising $30,000 for the establishment of a municipal electric light plant. A similar by-law submitted to the ratepayers one year ago was defeated by a majority of 38.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.

BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2290.

**ADVERTISEMENTS.**

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

**SUBSCRIPTIONS.**

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

**EDITOR'S ANNOUNCEMENTS.**

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**




**Electrical Development in Montreal.**

THE growth of electric lighting and power in the city of Montreal is astonishing. It is learned that, during the last four years the number of lights in use in that city has increased from 54,000 to 100,000. The Royal Electric Company have also in operation over 5,000 horse power in motors. Users of these motors have contracted with the company to run the machines only between the hours of 7 a. m. and 4 p. m. Thus the power load is entirely a day load, and does not in any way interfere with the lighting load. Between the hours mentioned the day load averages between 80 and 90 per cent. of the lighting load, a condition that is believed not to exist elsewhere in the world.

**Electricity on the Farm.**

THE employment of electrical energy for agricultural purposes has received considerable attention in Europe, and particularly in some parts of Germany. Near Ochsenfurt, in Bavaria, a company has been organized for the establishment of a large water power plant for the generation of electricity to replace animal power on the farms in the vicinity, the current to be distributed from a central station by means of sub-stations. Nearer home, however, we find an application of electricity for agricultural purposes on the Dentonia Park farm of Mr. W. E. H. Massey, situated but a short distance from the city of Toronto. Mr. Massey has installed in a unique power house an electrical plant for lighting and power purposes. There are twenty-six buildings on the farm which are lighted electrically. The plant includes a storage battery system capable of supplying 200 lamps for five hours. It is the purpose to operate the machinery on the farm by electric power. In a future issue we hope to publish an illustrated description of this plant.

**Questions and Answers.**

REPLIES to several problems pertaining to steam and electrical engineering will be found in the Questions and Answers Department of this issue. It is the hope of the publishers that liberal use will be made of this Department by our readers. If properly taken advantage of it should prove one of the most interesting features of the journal. Every effort will be made to give satisfactory answers to questions propounded. Our views will not, perhaps, in all cases, meet the approval of every reader. Those who may differ from our opinion are offered the free use of the Department to give their solution of any problem. It is in the widest discussion that the many interesting points can best be brought out and the most benefit derived to the student in the various branches of engineering. This Department should be of special benefit to superintendents and operators of steam and water power electric plants, in whose daily employment incidents are certain to arise concerning which they will require enlightenment. We ask the assistance of our readers in maintaining and broadening the influence of this Department.

**The Growth of Electrical Engineering.**

IT is gratifying to learn that the opportunities in the electrical business appear to be enlarging to such an extent as to attract many of the brightest young men in our leading scientific schools. In McGill University this year there are thirty fourth year students in the Engineering department. Of this number eighteen, or

sixty per cent., are taking the electrical course. The Electrical department is now taxed to its utmost capacty, and, notwithstanding the great improvements which have been made in this department during the last five years, the University authorities are now confronted with the problem of providing still greater accommodation, both as regards extra space and additional appliances. It is learned that a considerable proportion of the young men who have passed through this department have succeeded in securing positions of responsibility and at satisfactory remuneration. Quite a number are yearly absorbed by the electrical manufacturing companies, while others have found positions in the United States where the demand for highly trained men is much greater than in Canada. In this country also the number of important electrical enterprises is rapidly increasing, and with it the demand for young men with a scientific education.

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**Street Lighting in Toronto.**

THE question of street illumination is just now engaging the attention of the city council of Toronto. For this purpose both electricity and gas are now employed. The existing contracts expire on January 1st next. Tenders were recently invited for a renewal of the contract from that date. That the Council might be in a position to judge with some accuracy of the merits of the tenders submitted, two experts were appointed to report on the various forms of street lighting apparatus embodied in the tenders. There were submitted for their investigation by the Toronto Electric Light Company, nine types of lamps, three by the Kitson Hydro-Carbon Heating & Incandescent Lighting Company of Cleveland, four by the Carbon Light & Power Company of Philadelphia, and three by the Consumers' Gas Company, of Toronto, in all nineteen different forms of apparatus for street lighting. The tests were made in the School of Practical Science, and were conducted under conditions similar to those employed by a committee of the National Electric Light Association which reported at its recent meeting in Chicago. Judging by their original report, the experts appear to have made a somewhat comprehensive investigation, and their deductions seem to be in favor of the electric light. Their task was not an easy one, as there is no universally recognized basis of comparison between different lamps. The report shows that the maximum candle power of the open arc lamp under the conditions of the specifications is 1,119, and of the same lamp under paesent conditions 1,674. The maximum candle power of the Kitson lamp, which burns oil, is given as 907, while that of the hydro-carbon vapor lamp and of the ordinary gas lamp is much below these figures. The experts were apparently undecided as to the respective merits of the electric light, the Kitson lamp and the hydro-carbon lamp with special reflector. Following the original report, they submitted to the Council a supplementary document. This, while purporting to assist the Council in their task of deciding upon the most advantageous method of lighting, is to our mind rather contradictory and misleading. In it a statement is submitted of the comparative cost of lighting in the case of each form of apparatus by two methods of comparison, first, the price of one candle power, and secondly, the annual cost per mile of street illuminated in such a way that in each case the light midway between the lamps would be the same. For the purposes of this comparison the experts assumed an illumination equal to that produced by one candle at ten feet on a surface held so as to be best illuminated at that point. In the first column, which is the cost per candle, that for the open arc lamp is given as 10.71 cents, the Kitson lamp 11.08 cents, and the ordinary hydro-carbon lamp 89.9 cents. Looking at the second column we find that the cost per mile of illumination is given as $974 for the open arc lamp, $789 for the Kitson lamp, $1,387 for the ordinary hydro-carbon lamp, and $731 for the hydro-carbon lamp with special reflector. It seems strange that, while on the basis of cost per mile such a favorable showing is made for the hydro-carbon lamp with special refiector, the cost of candle power should have been omitted in respect to this particular type of apparatus only. The casual observer would probably conclude that on the basis of cost per mile the hydro-carbon lamp was cheaper than the electric light. It is unfair, however, to calculate on the basis of per mile of illumination, particularly with the special reflector, which throws most of the light in one direction, as most of the lights on the streets of Toronto are on street corners and diffuse light north, south, east and west. Another peculiarity of the report is that the point of illumination at which the tests were made was the minimum for the electric light and approximately the maximum for the gas light. Under the method of estimating, the electric light at its weakest point was equal to the gas light, but at every other point infinitely superior. This extra and increasing light at every other point than the minimum was not taken into account at all. The question as to which form of lighting should be adopted seems to be at once solved by a comparison of the tenders submitted. On account of lamps being located at intersections of streets, whether the arc lamp or the oil lamp is employed the same number of lamps will be required. The tender for renewing the present contract for electric lighting, with a lamp of the highest efficiency of any submitted to the experts, is $65.70 per lamp per year. Calculating on the basis of 1,000 lights, there would be a saving to the citizens of $25,000 per annum by the adoption of the electric light.

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**The Automobile Field.**

THE automobile is with us, and without doubt to stay, and we are assured upon all hands of the benefits to be derived therefrom, not only on the score of cheaper transportation, but in the matter of cleaner streets, better roads, etc. These things are true and obviously so, but one great change which will inevitably be brought about by the introduction of the automobile has not attracted the attention it deserves. Up till about twelve years ago passenger transportation in the cities was in the hands of the horse-car companies, while intercommunication between cities was entirely by steam. At the present steam transportation is decreasing for interurban short distance work, and its place is being taken by the electric road; the old horse-car systems for urban transportation are entirely superseded by the electric. These are days of rapid changes, and another change will take place within the next few years which will place the electric urban road where the horse-car road is now. For city work the great desiderata are rapid, frequent, flexible and cheap service, and the present electric systems have these advantages over the older horse-car systems, for which

reason the latter have been displaced. The demands for these advantages to a more marked degree are increasing, and that mode of transportation which will fulfill these conditions to the maximum possible will inevitably prevail. In the automobile we have something at hand which will give at least as frequent and rapid service, and will certainly be more flexible in meeting demands than the present electric lines for city service. As regards the cost of transportation, a little consideration of the elements which enter into the question will be necessary to form a judgment. Assuming that automobile bus-lines were initiated and run in competition with the electric cars, what would be their advantages from the point of view of operating costs. The largest item in the cost of electric transportation is generally that of motormen and conductors. This would probably not be decreased, nor would car inspection or repairs, by the use of the automobile. The next largest item is the fixed charges for interest, depreciation, taxes, etc. These depend upon the investment, and very slight consideration will readily convince the most skeptical of the smaller capital cost of the automobile. The electric line has a station costing about $100 per h.p., a permanent way valued at from $10,000 to $50,000 per mile, depending upon the nature of the structure and whether the paving is included, which is often the case ; overhead construction costing from $2,000 to $10,000 per mile ; cars and equipments from $2,500 to $4,000 each ; and in addition probably a percentage of receipts is demanded by the municipality for the franchise. The franchise also has to be obtained at frequently great cost and trouble. Against this, in favor of the automobile, no franchise is required, no permanent way, no overhead construction is needed. The busses will cost no more than the cars at the worst, and no station will be required unless the system be storage battery automobiles, and if required will be much less costly than for the electric cars both in total cost for the same traffic and for operating costs, the reason being that the station will be running at its full capacity at all times, thus requiring a smaller horse power of plant and having that plant operating at its highest efficiency at all times. In the case of steam or gasoline machines, no station whatever would be required. The busses would run upon any street and would never be blocked by interruption to the supply of power, street repairs, etc., and could be concentrated to meet sudden demands in a manner not approachable by the electric cars. Under these conditions the final triumph of the automobile for city transportation appears certain, the electric roads to be restricted to the interurban services where advantages may be had of greater speed over their own right of way than would be permissible in the case of an automobile line traversing the country highways. It may be questioned whether automobiles will be available for winter service in such places as Montreal and Quebec, and the point will be well taken at the present time, but those who predicted the use of electric cars in those places ten years ago were laughed at, and it may safely be predicted that the winter difficulties will be overcome as were those of the electric cars. As to the system of propulsion adopted at the present time, it would appear that steam would be the cheapest, but has the disadvantage over electricity of being more noisy and complicated, and for many reasons apart from cheapness electricity has the most to commend it. A further advantage of the automobile bus line lies in the fact that the public will be guaranteed a fair competition with consequent reduction in fares, as no monopoly can be granted as is done at present. The automobile is in the same position as regards the city business as the electric roads were about ten years ago, and the next ten may see as great a change in this regard as the last.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building.

MONTREAL, November 6th, 1900.

Fifty-two volt lamps, and apparatus generally fo rthat voltage, will, so far as Montreal is concerned, ere long be a "thing of the past." The Lachine Company serve at 110 volts, and all new connections made by the Royal Company are at 104 volts ; in fact, this latter company are gradually changing old 52 volt installations over. The Imperial Company are doing the same as the Royal. This in many instances will be beneficial, as there is quite a number of houses wired for too great a percentage of loss.

It is amusing to read in convention discussion that the Quebec Legislature are not "sharks," like the Ontario one, in regard to electrical taxation, etc. Give them time ; they are on better "pay streak" at present, but just as soon as they find that a few dollars can be squeezed out of electrical industries, they will "get there" quick enough, and it is easy betting that they will leave their Ontario confreres "miles behind." The Montreal City Council are at the present moment scheming around as to how they can best have a good "crack" at it.

According to the Inspection Department, there are over 40 firms (sic) doing construction work (interior wiring) in Montreal. Who they all are and how they manage to eke out a living (if they do are questions that would puzzle a Philadelphia lawyer. Variations of 300 per cent. have been noticed among tenders, i.e., by those parties mean enough to take a dozen or so of tenders, and who generally scheme to get a reliable firm to accept the figure offered by the unreliable. The remedy here is an old, though slow one, "The survival of the fittest."

Mr. Robertson, E.E., on the occasion of his marriage lately, received a very handsome present from the staff and fellow employees of the Royal Electric Company, in the shape of a handsome oak case of cutlery. Mr. Robertson was completely taken by surprise. It may do him good to know that he is held in equal esteem by those in the trade generally, as well as by his fellow employees.

On the occasion of the formal opening of the Royal Victoria College for women, by Lord Strathcona and Mount Royal lately, the evening's illumination of the building was striking. The outlines of the college were all picked out in incandescent lamps, and in several places heraldic shields, set with appropriate colored lamps, were hung. The work was placed in the hands of the Royal Company, and executed under the supervision of Mr. J. A. Douglas, superintendent of the interior wiring staff.

How strange it is that if one were to choose to go about Montreal electrical supply houses, he would be able to get four or five prices on regular standard supplies, and yet if one went from the east to the west of the city he would not find a variation of a fraction of a cent. in purchasing say a pound of sugar, loaf of bread, or yard of cotton. This surely is not as it should be, and ought to be easily remedied if the dealers would get together and talk the matter over.

It is to be regretted that the old and tried city surveyor of Montreal, Mr. P. W. St. George, C. E., has had to tender his resignation, being simply driven out of his position, I understand, by unfounded charges made by an incompetent and grossly unjust Road Committee. Such treatment is, however, on a par with usual municipal management here. The question interests certain of the local electrical fraternity, as the permission for location of poles is vested with the city surveyor, and it is ten chances to one that we will have a successor who will try to do his duty in a just and conscientious way, as Mr. St. George has done.

## THE BREMER ARC LAMP.

THERE have been many attempts at treating arc-light carbons by impregnation and in other ways, which have had the effect of making the arc burn more quietly and imparting a somewhat better color to the light, but no striking results have heretofore been achieved.

But according to some tests made by Herr W. Wedding, whose experiments are recorded in the Elektrotechnische Zeitschrift, and summarized by the Engineering Magazine, a decided advance has now been made by Herr Bremer, who prepares carbons containing from 20 to 50 per cent. of non-conducting salts of metals, such as calcium, silicon and magnesium.

The first measurements made were of a continuous-current arc lamp taking about 12 amperes. The positive carbon was the only one specially treated, and it contained a calcium compound. In the article just mentioned are given tables and curves of illumination at various angles with the horizontal, from which it appears that when no globe was used, the mean hemispherical intensity of the light was 4,320 candles. The average current through the lamp during the run was 12.3 amperes, the mean electro-motive force 44.4 volts, so that the average power used was 546 watts, or 0.126 watt per candle.

The same lamp with a globe had a hemispherical intensity of 2,772 candles and used 543 watts, or 0.196 watt per candle.

The second lamp tested is similar to one now hung on the Eiffel Tower, in Paris, at an elevation of 95 meters. It has four arcs, takes about 60 amperes of continuous current, and the positive carbons contain a calcium compound, as before. On account of the great intensity of the light the tests had to be conducted at night and in the open air. The lamp was hung 8 meters above the ground, and the illumination was measured on a surface 1 meter from the ground and at different distances from the lamp. From the observed results it was found that the maximum intensity of the light when no globe was used was 83,000 candles, at an angle of 37 degrees below the horizontal, while the mean hemispherical intensity was 49,730 candles. The average current was 55.8 amperes, the electromotive force 89.3 volts, so that the power used was 4,980 watts, or only 0.1 watt per candle. When covered with a globe, the hemispherical intensity of the light was found to be 26,890 candles, and the power used 4,610 watts, or 0.17 watt per candle. From the above figures, it appears that for the arc lights without globes the power used was hardly more than 0.1 watt per candle. Herr Wedding states that the lowest power consumption he had ever found with other kinds of lamps was 0.3 watt per candle, and that the average was between 0.4 and 0.5 watt. The new lamp, therefore, is three times as efficient as the best of the old ones, or, putting it another way, with the same power three times as much light is produced.

An alternating-current arc lamp with one of its carbons treated by the Bremer process was measured without a globe and found to have a mean intensity of 512 candles and to use 0.5 watt per candle. This shows a decided improvement on previous alternating-current arc lamps, and it is believed that with better construction even more favourable results can be obtained.

The regulating mechanism, which works smoothly, is much simpler than in the ordinary kinds of lamps, but the details are not yet ready for disclosure. In the ordinary lamps most of the illumination comes from the glowing carbons, but in the new lamp the arc itself furnishes considerable light, and so makes a more even distribution of illumination. Above the arc and surrounding the upper carbon is a conical tin hood, which helps to retain the heat generated in the arc and also acts as a reflector. Some of the products of combustion settle on the inner surface of this hood in the form of a pure white powder which makes an admirable reflecting surface and helps in the even distribution of light, so that the lamp globe, when on, appears uniformly illuminated and the upper half is not in the shade, nor are sharp shadows of the negative carbon and its holder cast on the lower hemisphere.

Favourable photometric measurements alone do not make a lamp successful. Much depends upon the æsthetic impression which the light makes on the eye, and in this respect the new lamp is not wanting. The large amount of calcium contained in the carbon gives rise to a rich yellow-red radiation, in contrast with the usual bluish-violet rays of the arc, so that the light has a much warmer tone. According to the inventor, the colour of the light can be regulated at will by varying the composition of the carbons.

The richness in red rays of the Bremer lamp led Herr Wedding to try some experiments to determine how well it could penetrate fog and mist. He took a lamp of the ordinary kind and a Bremer lamp and interposed a cloud of steam about 1 meter thick betwen them and a photometer. Repeated observations showed that the penetration of the new light was twice as great as that of the old. This result points to the applicability of the Bremer lamp to lighthouses and signal lights where the penetration of fog is of consequence.

## PERSONAL.

Mr. J. W. Marr has been appointed electrician for the Toronto Evening Telegram building.

Mr. Albert Courtney has been engaged as superintendent of the electric light plant at Walkerton, Ont.

Mr. W. R. Miller has been elected a director of the Montreal Telegraph Company to fill the vacancy caused by the death of Mr. Henry Archibald.

Mr. Jos. H. Ward, late electrician for the Grimsby Electric Light Company, is now head engineer in Messrs. J. Cobbledeck & Son's mill at Exeter, Ont.

Mr. C. W. Dill, assistant city engineer of Nelson, B. C., recently tendered his resignation, and has been engaged as superintendent of construction in connection with the municipal power development at Bracebridge, Ont.

Mr. John Hudson, president of the American Telephone & Telegraph Company, successors to the American Bell Telephone Company, died very suddenly at Beverley, Mass., October 31st. For over 20 years deceased had been closely connected with the Bell Telephone interests.

Mr. Ezra Good, who held a responsible position in the works of the Canadian General Electric Company at Peterborough, was tendered a complimentary banquet by the employees of the company a few days prior to his departure from the town. Mr. Good carries with him in his new field the best wishes of many friends.

Mr. C. J. D. Baby, late chief accountant of the Cataract Power Company, of Hamilton, and now assistant manager of the Packard Electric Company, St. Catharines, was presented before leaving Hamilton with a solid silver tea service by the officers and staff of the Cataract Power Company. The presentation was made by Mr. Gordon J. Henderson.

At the recent convention of the American Street Railway Association, which opened in Kansas City on October 17th, the following representatives of Canadian roads were in attendance: C. E. A. Carr, manager, and E. R. Carrington, of the London Street Railway Company; M. Powers and J. M. Smith, of the Toronto Railway Company; C. K. Green, manager, and J. B. Griffith, purchasing agent, of the Hamilton Street Railway Co.

Mr. F. B. Brothers, formerly manager of construction for the Montreal street railway system, but who for the past year has been superintending the construction of an electric railway in Georgetown, British Guiana, returned to Montreal a few weeks ago. His visit, however, was of short duration, as a fortnight ago he left for Cuba in the interests of The Cuba Company, of whch Sir William Van Hörne is president. Mr. Brothers will assume charge of the construction of several hundred miles of steam road. The work will be on a most extensive scale, and it is expected that 3,000 men will be employed.

Mr. Charles Tollington, representing the Bagley & Wright Manufacturing Company, cotton spinners and manufacturers, Oldham, England, was a recent visitor to the office of the ELECTRICAL NEWS. Mr. Tollington's headquarters are in Montreal, his company having established a Canadian branch at 318 St. James street in that city. The company are introducing to the Canadian trade their covering for electric wires. Having had many years' experience in the manufacture of cotton, they claim to be in a position to furnish just what is required for electrical purposes. It is possible that the company may establish a branch in Toronto.

Geo. S. Munro met death in the Brant hotel, at Brantford, by coming in contact with a live electric wire.

The London & Vancouver Finance & Development Company give notice of their intention to build a tramway from a point on the Chemainus river to the town of Chemainus, and to operate telegraph and telephone lines in connection.

# The Incandescent Lamp

By H. D. Burnett.

THE following interesting paper pertaining to the development of the incandescent lamp was read on October 23rd at the second semi-monthly meeting of the Peterborough Engineering Club by Mr. Henry D. Burnett, superintendent of the lamp department of the Canadian General Electric Company.

The present year marks the close of the second decade in the history of the commercially successful incandescent lamp. The closing twenty years of the 19th century have witnessed a development of electrical industries that, in the magnitude of interests involved, capital invested, employment of labour, and display of inventions, presents no parallel in the world's history. The invention of the modern incandescent lamp, about 1880, was probably the principal factor in causing this wonderful development of electrical machinery and general appliances. The incandescent lamp having become an accomplished reality, there sprang up a greatly increased demand for the electric dynamo for supplying current to such lamps, and with increased use a vast amount of scientific skill and ingenuity was applied to its development and to enlarging its field of usefulness.

A great number of subsidiary electrical appliances became necessary; switches, cut-outs, measuring instruments and other station equipments, together with distributing systems, etc. After the establishment of a net-work of wires throughout each large city for the supply of current to the lamps, it was a natural and easy step to devise electric motors that could be run by the current from the same lighting circuits. And the wave of electrical invention spread with increasing rate of speed from year to year, until to-day we witness a display of electrical machinery as applied to nearly all branches of arts and industries that is simply marvellous

This paper has to deal with an apparently insignificant example of the application of electricity to one of the very useful arts, that of supplying light. The magnitude of the incandescent lamp industry to-day is best understood from the fact that no less than 25,000,000 lamps are manufactured and consumed yearly, and the consumption is rapidly increasing. The importance and commercial value of this little transformer of energy may, perhaps, be appreciated by the fact that it has probably been the subject of more prolonged, obstinate and expensive patent litigation than any other subject or article in the history of inventions.

The invention of the incandescent lamp is, in America at least, almost universally ascribed to Thomas A. Edison, who received his fundamental or basic patent from the United States' patent office, Jan. 27, 1880. This first important patent bearing upon the Edison Carbon Filament Lamp was applied for two months earlier, in November, 1879. This, then, may be taken as the date of birth of the modern incandescent lamp, and to Edison, undoubtedly, is due the credit of being the first one to produce a practical and commercially successful incandescent lamp. But it is a popular error to assign to him the credit of being the first or original inventor of an incandescent lamp. There are many who, no doubt, would be surprised to learn that over thirty years before Edison ever started to experiment in this line, there were incandescent lamps made and patented that consisted of a carbon burner contained in a glass bulb from which the air had been exhausted, which burners were made incandescent by passing the electric current through them. This description to many a casual observer might be considered as describing the present incandescent lamp, so familiar to us all.

Prior to November, 1879, when Edison applied for his celebrated carbon filament lamp patent, there had been produced no fewer than twenty different incandescent electric lamps, by as many different investigators, including English, French, American and Russian, most of which were patented, and all of which differed from each other in more or less important details. The first of these, having a platinum wire for the incandescent part, was patented by Frederick de Moleyns in 1841. It is certain that from that date up to 1879 there was a great deal of attention given to this subject of the incandescent electric lamp. It may then be of interest, now that the smoke of this memorable legal battle has cleared away, to consider for a few minutes the questions: Who was the real inventor of the incandescent lamp? What was the important step in the prolonged series of experiments that brought about a successful lamp? To what extent is Edison entitled to being called the "Father of the incandescent electric lamp?"

The essential and indispensable elements of the incandescent lamp to-day are as follows:

1st.—A bulb or receiver composed entirely of glass.

2nd.—A vacuum of high degree inside the bulb.

3rd.—A filament of carbon having very small cross section and high resistance.

4th.—Platinum wires passing through the wall of the bulb and sealed perfectly by fusion of the glass about them, for conducting current to the filament.

5th.—Suitable joints or connections between the filament that is to become white hot and the metallic leading in wires that are to be kept as cool as possible.

6th.—A base of any suitable substance secured to bulb and bearing two metallic contracts insulated electrically from each other, and connected respectively to the two wires passing through the glass, this base being for the purpose of entering the socket joined to the electrical circuit.

There has never been a commercially successful incandescent lamp that did not embody in its construction all of the six above named elements. Edison's lamp of 1880 contained every one of these elements. Every incandescent lamp made prior to Edison's experiments had one or more of these elements wanting. There have been various attempts made during the last twenty years to construct lamps lacking one or more of these essential elements, or containing important modifications of these elements as stated. Such lamps have usually had a very short history. They have either been found to contain some inherent defects, or have been unable to compete in the open market with the standard lamp embodying the elements mentioned.

Examples:—Westinghouse "Stopper Lamp" with cement filling. Pollard Lamp with silver powder to replace platinum leading wires; Novak Lamp (no vacuum), said to contain iodine. Found by analysis to contain carbon tetra chloride h cl vapour and c.l. gas with trace of nitrogen. (These types of lamps were shown and described by Mr. Burnett.)

We will now consider some of the earlier types of lamps and note what important elements were lacking in them and stood in the way of their success.

It was an American named J. W. Starr, a resident of Cincinnati, who is entitled to the credit of having produced the first incandescent lamp using carbon for the burner. This carbon, obtained from gas retorts, and in the shape of small pencils or thin plates, was enclosed within a glass bulb to which was attached a glass tube about 30 inches long. The bulb and the tube were filled with mercury and then inverted, allowing the mercury to run out from the bulb, leaving in its place a Torricillian vacuum. The carbon pencil was attached at one end to a platinum wire which was sealed into the top of the bulb, and at the other end to a copper wire which dipped into the mercury. This lamp had not the high resistance filament nor the all glass receiver of the modern lamp. It burned remarkably well for the first attempt in this direction, but the lite of the carbon must have been very short. A chandelier of 26 of these lamps was on one occasion exhibited in public, symbolical of the 26 States of the Union, which display was admired by the great physicist Faraday. This lamp was patented in England by King in 1845. While Star was the first to produce a carbon, vacuum, incandescent lamp, he was not the first to cause carbon to become incandescent by means of the electric current, while protected by a vacuum from combustion. The principle that light and heat could be produced by passing the electric current through poor conductors was well known in the beginning of this century. Sir Humphrey Davy, who in 1809 discovered the phenomenon of the voltaic art, which is reproduced in the commercial arc lamp of to-day, also experimented in the line of producing light from carbon rendered incandescent by the electic current. His vacuum was underneath the bell-jar of an air pump. So far as known Davy did not attempt to apply these principles to a portable incandescent lamp.

The first incandescent lamp was that of De Moleyn's, already

referred to, which had a platinum wire for the burner. This was patented in 1841. Then came Star's carbon lamp of 1845, already described. The following year Greener and Staite took out a patent for a carbon lamp similar to Star's. In 1849 Petrie patented a lamp in which iridium was used as the burner. Then followed in succession the charcoal rod lamp of Nollet & Sheppard in 1850, the graphite coke lamp of Roberts in 1852, DeChanzy's lamp of 1857, of which he produced, it is said, 12 lights of great steadiness run from 12 Bunson elements; Gardiner & Blossom's platinum wire of 1858, and Adam's platinum wire lamp produced in Boston in 1865 but not patented. All of these lamps were little more than laboratory experiments and attained no commercial importance. In 1873 Lodyguine, a Russian physicist, produced a double carbon burner lamp with which he lighted a public hall in St. Petersburg on the occasion of a number of evening lectures which he delivered on the subject of electric lighting. He used nitrogen in his bulb instead of a vacuum. This was a step backward in the art, and beyond some improvements in details, his lamp was no great advance over its predecessors. For his experiments and researches on carbon as a material for such lamps, in which he showed its decided superiority over platinum, he was awarded a prize by the St. Petersburg Academy of Sciences. This lamp started a new list of experimenters on this subject of the incandescent lamp which had lain practically dormant since Star's lamp demonstrated its own impracticability.

Kosloff went from St. Petersburg to France in 1875 and exploited a lamp which he considered an improvement upon Lodyguine's, in that it had a series of carbon rods thrown successively into action as each one burned out.

Kohn, the same year, patented a similar lamp in England, while Khotinsky in France brought out another multiple carbon lamp. He proposed the arrangement of the lamps in multiple arc and provided a key by which to light or extinguish the lamp at will.

The next year, 1876, Bouliguine constructed a lamp with a single long carbon in holders so that only a small section of the carbon was in circuit at one time. When one section burned out another section was shoved up by the mechanism of the lamp.

This same year, 1876, just one year before Edison began his experimenting along this line, Woodward, in the United States, patented a lamp made from a glass tube, hermetically sealed at each end where the wires entered to conduct current to the small sheet of carbon that constituted the burner. The wires, however, were not sealed into the glass by fusion. The lamps were to be placed in parallel on the electric circuit. The lamps were to be first exhausted, then filled with a rarified gas that did not support combustion. This patent was afterwards bought by the Edison Company.

The period from 1875 to 1879 was one of great activity for inventors in this apparently very alluring field of incandescent lighting. I have referred to the work of Kosloff, Khotinsky and Bouliguine in France. In England there were Kon, Scott, Pulvomachear, Vanchoate, Lane, Fox and Swan, while in the United States the subject was being investigated by Farmer, Woodward, Sawyer and Man, and Edison, and I suppose I should also include the name of the now famous Henry Goebel, who was discovered in 1893, about thirteen years after Edison's patent was issued, by the opponents of Mr. Edison, in his famous series of patent suits against infringers. Mr. Goebel claimed to have made incandescent lamps in considerable numbers during the years extending from 1854 to 1880. He passed through the period when Edison's name was heralded throughout the country as the inventor of a successful lamp, which would bring him untold wealth, and yet he never thought of applying for a patent on his own so-called invention, although he was fully alive to the value of patents, for he had applied for one on another invention.

The activity displayed by lamp inventors during these few years, just prior to Edison's success, is, perhaps, illustrated by the fact that a Frenchman named Fontaine found sufficient matter of interest bearing on the subject to induce him to write a book on the incandescent lamp and electric lighting.

Thus, quite contrary to the popular conception of the subject, Edison, the father of the incandescent lamp, so far from being the first producer of such an article, had access to a book on this subject which was issued in 1877, before he began his regular experiments in this line. This book is very interesting, in that it describes some experiments made by the author on the best types of lamps in use at that time, and we are thus made informed of the state of the art two years before Edison's invention of the successful modern lamp.

Fontaine, referring in his book to Kohn's lamp having several carbons, says: "When the receivers are sealed and the contacts carefully put in line the carbons last for a satisfactory period. The first carbon of a lamp never lasts for less than a quarter of an hour, while its average duration is twenty-one minutes. The succeeding carbons last upon an average for two hours, so long as the luminous intensity does not reach forty burners, (equivalent to 380 c.p.), in which case the average duration is only half an hour. The vacuum never being perfect in the receivers, the first carbon is in greater part consumed. It would appear that, consequent upon the little oxygen contained in the lamp being transformed into carbonic acid and carbonic oxide, the carbons should be preserved indefinitely. But there is then produced a kind of evaporation which continues to slowly destroy the incandescent rods." From these experiments it was concluded that there existed this inseparable obstacle to success with carbon as the material for the burner. Note that these lamps tested by Fontaine gave light of about 300 c.p. each. Fontaine appreciated the desirability of obtaining smaller units. He thought that if one lamp on a certain number of battery cells gave 300 c.p. of light, a number of these, say six, arranged in series on same circuit, ought to give 1-6 of 300, or 50 c.p. each, and when he got with this arrangement practically no light from any of the lamps, he could not understand the reason, and after trying also the multiple arrangement of the lamps, concluded that the sub-division of electric light by means of incandescent lamps was an impossibility.

With these lamps described by Fontaine, as well as the ludicrous results of his experiments in the immediate back ground, and with a perspective view of nearly forty years of spasmodic but persistent attempts to produce a practical incandescent lamp, the brilliant achievement of Thomas A. Edison in this well-beaten road, is worthy of our highest admiration. Undaunted perseverance is the distinctive trait in this man's character, to which we are indebted for the incandescent lamp, as well as numerous other valuable inventions connected with his name.

Probably turned aside at first thought by the numerous failures associated with carbon as the material for a burner, he first gave his attention to platinum, as more likely to afford a staple burner or filament. He produced and patented a lamp having, unlike previous platinum lamps, a filament of comparatively high resistance, which was provided with an automatic cut-out for switching out the filament when its temperature reached that point at which there was danger of its melting. This lamp was little more than an electric vibrator, caused by the continuous action of the cut-out device. Undismayed at this failure in this line, he turned his attention to carbon, and after about a year of experimenting brought out his high resistance carbon lamp, of substantially the same type as that in use to-day.

The important respect in which Edison's lamp differed from all previous lamps was that it possessed the long slender carbon of such high resistance as to permit of the divisibility of the light into small practical units. He displayed a wonderful ingenuity in devising means of manufacturing these threadlike filaments, but when he had gone thus far, had he been contented with the means previously used for securing and retaining the vacuum necessary for the preservation of such a filament, he would have met nothing but failure.

He was the first lamp maker to construct the walls of his vacuum chamber entirely of glass, with the glass melted about the wires that carried the current to the filament. This combination, then, of the high resistance threadlike carbon, with the all glass bulb holding a high vacuum, and the conductors passing through the glass, constituted Edison's great invention.

All carbons used in previous lamps were short and comparatively thick, or of large section, making their resistance low, less than five ohms, as compared with Edison's filament of one hundred ohms or higher resistance. This low resistance necessitated large current, and correspondingly large conductors for the current. Large metallic wires are good conductors of heat. Hence the heat was drawn away from the burner and the unequal expansion of the wires and the material about them caused air leak into the lamps. There was not a lamp made before Edison's time that had a practicable seal for retaining a perfect vacuum. There have been numerous attempts in recent years to make so called improvements upon the Edison all-glass globe, sealed by fusion of the glass, but no such attempt has ever been successful in producing a commercially satisfactory lamp. With the modern lamp, having a carbon filament or burner about 1-200 of an inch in diameter, it is of vital importance that there shall be absolutely no leakage of air into the lamp after the lamp has been exhausted. At the very outset of his experiments with carbon for a

burner, Edison adopted the only method of sealing or closing the vacuum chamber that has ever been found to be perfectly effective in holding the vacuum of high degree necessary in the incandescent lamp. The lamps exhausted by Edison eighteen years ago have just as good vacuum to-day as he produced in them at that time. I have before me a lamp made by the Edison Lamp Company fifteen years ago, and it now has just about as good vacuum as we produce in our lamp to-day. The marvellous ingenuity displayed by Edison in solving the numerous knotty problems connected, first, with the production of a successful lamp, and secondly, with its economical manufacture, has won the admiration of every lamp expert who has studied the early history of this invention. Even to-day, with all the knowledge of the art of lamp manufacture, coming from a practice of twenty years, it is an exceedingly difficult matter for any manufacturer to turn out lamps in commercial quantities, having a uniform grade of excellence, so exceedingly sensitive in this article to the minutest defect in any part of its construction.

That the problem of its first development was no trifling one is shown by the fact that Edison, with his wonderful fertility and unrivalled energy, spent nearly all his time for six continuous years in developing and perfecting his lamp, its manufacture and his system of lighting. During this time he spent on this work about $100,000, and during these six years took out in the United States alone over eighty patents pertaining solely to the incandescent lamp and its manufacture. In his search for the best material for a filament, he tried every substance that he could procure in the animal, vegetable and mineral kingdoms. He sent special envoys to South America, Central America, West Indies, China, Japan, India, and elsewhere, in search for a suitable fibre, and finally adopted for this purpose a certain selected growth of a particular variety of bamboo found in one of the inland districts of Japan. Of this material only a selected portion, that immediately below the outer skin, was found suitable.

Strange to say, after twenty years of experimenting with all kinds of materials, natural and manufactured, there are lamps of certain classes being made to-day out of this same grade of Japanese bamboo that are superior to lamps having filaments made of any other material designed for the same purpose.

To illustrate Edison's remarkable perserverance and capacity for work, there were times when for two weeks he never left his laboratory to go to his house, which was but a short distance away.

On one occasion, in Newark, when a certain printing telegraph machine failed to work to his satisfaction, he locked himself up in his room with five assistants, it is said, and declared he would not leave until he had made it work, and work it did, although it required sixty hours continuous labour.

Let us now consider briefly the improvements that have been made in the incandescent lamp during the twenty years of experimenting and commercial manufacture. The bulb has changed only in shape. The first bulbs used by Edison were blown from glass tube. Then came the free blown bulb obtained from the glass works, which was used for eleven years by the Edison Lamp Company, which has always been by far the largest lamp manufacturer in the world.

For the last eight years the moulded bulb has been used almost exclusively by all lamp factories. The method of sealing the bulb to make it absolutely air tight is practically the same now as it was twenty years ago. The vacuum obtained by Edison in his early lamps was just as good as that produced to-day by those lamp factories that exhaust their lamps by the use of mercury pumps. The Ebison Lamp Works in the States, and the Canadian General Electric Company's Works at Peterborough, are using an improved chemical method of exhausting, which gives not only a superior vacuum to that obtained by the mercury pumps, but also a far more uniform grade of vacuum in all the lamps. Edison required six hours to produce his vacuum. To-day we produce the same in less than one minute. The shortest time required by mercury pumps is about one-half hour.

The filament used by Edison in his first experimental carbon lamp was made from carbonized paper, but this very soon gave place to bamboo, and this material was then used exclusively by the Edison Company for all classes of lamps up to 1894. The Sawyer Man Company, as well as the Thomson Houston Company at Lynn, also used the same material, while other companies were using carbonized silk and cotton thread, and a few amorphous cellulose. This last mentioned material has been used by all the principal companies during the last few years. It is very much cheaper to work than bamboo, is more homogeneous and better adapted to make the long thin filaments necessary for low candle power lamps.

The principal improvements in the quality of the lamp during the last twenty years have been on the filament, and pertain chiefly to improvements in the method of treating or flashing the carbon base, whereby a hard, dense grey coating is deposited upon the surface of the filament. The method employed in making this deposit of dense carbon determines largely the life of the lamp, the maintenance of its candle power and efficiency, and the uniformity of product as to voltage and power consumption. This operation of treating the filament is now performed by automatic apparatus designed to break the electric circuit at the instant when the hot resistance of the filament has reached the desired point. All lamp manufacturers use the process of treating. So that whatever the material used in making the filament, whether bamboo, silk, cotton thread, or cellulose, it is in all cases given a very similar surface coating, all factories using for this purpose some of the various forms of hydro-carbon.

They all keep as secret as possible the various details of their methods of manufacturing this part of the lamp, and the difference in the quality and behaviour of different makes of lamps is traceable chiefly to the different methods of preparing the filament and handling it throughout the several stages of its manufacture.

The process of treating the filament in order to make the surface coating, which I have mentioned, is one of the most beautiful and interesting phenomena in the art of electric lighting. The carbonized thread, already shaped like the filament, is inserted in a bottle from which the air is then exhausted. The bottle, by means of valves and pipes, is then placed in connection with another bottle containing one of the many forms of hydro-carbon liquid, such as gasoline, and the vacuum above the liquid causes it to evaporate rapidly and fill the treating bottle with hydro-carbon gas or vapor. The electric current is now sent through the filament, causing it to become incandescent, as it does when in the finished lamp. This vapor, coming in contact with the white hot filament, is chemically decomposed or broken up into its constituent elements, and a pure carbon, similar in nature to graphite, is deposited on the surface of the filament base, which is also almost pure carbon but of less dense structure and resembling wood charcoal. This operation of artificial growth or enlargement of the filament continues until it has attained the proper electrical resistance, when the current is cut off and the filament is removed from the bottle. The filaments need to be designed of such size and length that when the treated coating has attained the proper thickness, the resistance of the filament will be from 30 to 50 per cent. of the resistance before treating, the per centage varying with different classes of lamps. The time required to make this deposit varies in different cases from a few seconds to half a minute, and longer in some special cases. The resistance of the filament, when in the treating bottle, falls very rapidly since the deposited carbon has about one-sixth to one-tenth the specific resistance of the base carbon.

The most beautiful phenomenon in connection with treating the filament is that of rendering it perfectly uniform in resistance and brilliancy throughout its length, provided the treatment is continued a sufficient length of time. This action will be best understood by reference to a diagram and a little supplementary explanation.

Very strange to say, this process of treating the filament, so essential to the highest quality of lamp, was invented and patented before Edison had produced his first successful carbon filament lamp.

The patentees, Sawyer and Man, although four years ahead of Edison in the production of a carbon burner lamp, would probably never have had any commercial use for their process of treating, and probably would never have appreciated its immense importance and value, had there not been invented a commercially successful high resistance carbon lamp to which the process was more perfectly adapted. Had Edison applied this treating process to his perfected bamboo filament, for which he would have been obliged to pay royalty to Sawyer and Man, he would have produced a lamp twenty years ago that on test by the most severe of modern methods, would have compared very favourably in all respects with the best lamp made to-day.

Edison knew that his competitors could not make a successful lamp without infringing on his own patents, and he did not propose to be indebted to any other individual in the manufacture of a successful commercial incandescent lamp which he considered his own, and his greatest invention. He therefore set at work to discover some other means of accomplishing the same result

He concocted a fluid in which he dipped his bamboo filaments prior to carbonizing, and by this means did effect a great improvement in the material, but the process was by no means equal to the treating process. Edison, with characteristic shrewdness, kept his process of preparing the filament a secret, and to make doubly sure that those engaged in manufacturing the lamps would not become acquainted with the filament process, had this work done under his personal supervision at a small shop several miles away from the lamp works. For about twelve years the Edison Company used this dipping process of preparing their filaments in place of the hydro-carbon treating process. Many of you are no doubt familiar with the old Edison lamp with glossy black filament, which would start at 16 c. p. with an efficiency of 3.1 watts per candle, and in less than 100 hours would be down to 12 c. p. with an efficiency of four or more watts per candle, and the decline in candle power and efficiency continued until, at the end of three or four hundred hours, the candle power was perhaps ten and the power consumption five or more watts per candle. Do you wonder, then, that these lamps after this gave very long life? And yet, you will run across a man now and then, even to-day, who will declare that the lamps made to-day cannot compare with the good old Edison lamps of ten years ago.

When the treating patent expired the Edison Company hastened to abolish the old Edison dipping process, and for the last eight years they have been treating all their filaments with the exception of those used in their 200 to 250 volt lamps, which are not treated, because it is impracticable to make treated filaments of sufficiently high resistance and of sufficient mechanical strength and sufficiently small surface to be used at such high voltage, and give as low as sixteen candle power.

I may add, however, that the treating process is not so necessary with the cellulose squirted filament as it was with the bamboo, since the former is much more homogeneous and uniform in section and surface than was the bamboo.

The lamp with untreated filament will decline in candle power much more rapidly than the treated filament designed for the same candle power, voltage and efficiency. For candle power, maintenance and useful life, the 200 v., 16 c. p. 4 watt lamp with untreated filament stands about midway between the 110 v., 16 c. p., 3 1-2 and 3.1 watt treated filament lamps.

I have now considered the changes that have been made during the last twenty years in the bulb, the vacuum, and the filament. There remain the three important elements, the leading in wires for carrying the current to the filament, the joints between those wires and the filaments, apparently insignificant but very important, and the base of the lamp for attaching it to the circuit.

For leading in wires platinum is used now, the same as it was by Edison, but the quantity used per lamp has been greatly reduced. There have been various attempts to substitute other cheaper metals for the expensive platinum, but none have proved commercially successful.

For joints Edison used a copper wire which was welded to the platinum at one end, and at the other flattened and bent about the carbon filament and finally copper plated. This was very effective and was used for many years, but the use of copper at the joint is somewhat detrimental to the quality of the lamp. At present the principal companies use a carbon paste for attaching the filament directly to the platinum wire. This is not only better, but cheaper than Edison's method.

The base used by Edison is used to-day with but very slight and unimportant modifications. There have been two dozen or more distinct types of base designed by different lamp companies that have started up during the last twenty years, and I have always admired the practical genuis of Edison who, in this, as in many other ways, hit upon just that form, that after twenty years of experimenting on the part of rivals, has survived nearly all other forms of bases and is to-day not only the best but also the simplest and cheapest to manufacture.

Having considered the most important movements that have been made in the incandescent lamp during the last twenty years, I will now treat very briefly of the present method of lamp manufacture. As most of you have probably visited our lamp works, you are already familiar with the main mechanical processes, and I will not need to dwell upon these.

The filament is made from cotton in its original state. This is first thoroughly cleansed and then digested with chemical ragents until it is reduced to a gelatinous state resembling glue. After standing some length of time it is put into a mechanical mixer and thoroughly churned, then strained and exhausted to remove all air bubbles. It is then introduced into a special bottle containing a very small circular aperture or die in its lower neck, and by means of compressed air on top of the mass it is squirted through the die into alcohol, which causes it to coagulate into a white thread, which after being washed is wound onto a drum and allowed to dry, when it very much resembles horse hair. This is gauged and sorted, wound unto suitable forms to give it the filament shape, and then subjected to the baking process. The filaments are placed in graphite crucibles, surrounded by graphite or other material to exclude the air, and then gradually raised in a furnace to a very high temperature, sufficiently high to melt iron but not platinum, and so held for several hours until all the volatile matter is removed from the filament in the shape of gases. When removed from the furnace, the filaments are almost pure carbon and very smooth and glossy. They are now ready for the next process, treating, which has been described.

## EFFECT OF SCALE IN BOILERS.

THE commonly accepted idea is that the efficiency of a steam boiler is seriously affected by an accumulation of scale. Perhaps the most often quoted estimate is that the presence of 1-16 in. of scale causes a loss of 13 per cent. of the fuel burned, ¼ in. 38 per cent., and ½ in. 60 per cent. Recently, says the Street Railway Review, we have seen published statements tending to show that the loss of efficiency due to scale has been greatly over-estimated.

Prof. R. C. Carpenter, of Cornell University, writing in the American Electrician, says that so far as he is able to determine by tests a lime scale, even of great thickness, has no appreciable effect on the efficiency of a boiler. A test which he conducted when the boiler was thickly covered with lime scale showed practically as good results as when it was perfectly clean. The explanation is that the heating capacity is affected principally by the rapidity with which the heated gases will surrender heat, as the water and metal have capacities for absorbing heat more than a hundred times faster than the air will surrender heat. Any deposit which curtails slightly the capacity of absorbing heat on the water side has very little effect either on total capacity or efficiency. A thin film of grease, however, being impermeable to water, keeps the latter from the metal and generally produces disastrous results.

Mr. Walter M. McFarland, formerly an engineer officer in the United States Navy, in the course of a lecture at Sibley College, Cornell University, stated his experience had been that a considerable thickness of clean uniform scale made apparently little difference in the efficiency of the boiler. On the U. S. S. Vandalia there were two boilers used for distilling water, and the water evaporated per pound of coal was no more when the boilers were clean than after three months when the scale was nearly ¼ in. thick.

On the other hand, there are recent tests showing that scale does reduce the efficiency. In May and June, 1898, Prof. L. P. Breckenridge, of the University of Illinois, made tests on a locomotive boiler before and after cleaning it of scale and found that the loss due to the scale was 9.55 per cent. The average thickness of this scale was 3-64 in.; analyses of samples taken from different points in the boiler showed from 20 to 67 per cent. calcium carbonate and from 4 to 40 per cent. calcium sulphate.

Also, copies of reports of tests sent us by the Union Boiler Tube Cleaner Co., of Pittsburg, show that there is a marked increase in the efficiency of the boilers after the scale has been removed. In one case the gain was 16.3 per cent. and in another 24.8 per cent.; the thickness of the scale was not stated.

## FREE SCHOLARSHIPS.

The trustees of the American School of Correspondence, 156 Tremont street, Boston, Mass., have decided to depart from custom in their policy of promotion. Believing that a personal exposition of the advantages of a school is often better than, or at least, a great help to printers' ink, they have announced their willingness to grant a limited number of free scholarships to men in various large establishments and parts of the country. We are not advised of the exact conditions, but anyone who thinks he would like to have one is invited to correspond with them, giving his occupation, and his application will receive consideration by the trustees. The school calls attention to its coures in mechanical and electrical engineering (including a complete course in mechanical drawing), the former including steam, locomotive and marine engineering. As its work is confined to these branches, they point out the probability of better work being done than would be likely where many other branches are taught.

## BY THE WAY.

The manager of a gas company in one of the leading cities of Canada is having built a new residence in a choice residential district where electricity is almost universally used for house lighting. He complains of having been pestered by electric wiring firms desirous of securing the contract for wiring his new house. The idea had not occurred to these enterprising contractors that it would never do for the manager of a gas company to light his house by electricity. When so informed they gave the gas manager a look expressive of their deepest sympathy with a man who was prevented by circumstances from adopting up-to-date methods.

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In the past great difficulty has been experienced in wiring, for electric light, without damage, residences which are decorated. Wiring men have been obliged to abandon the idea of getting to outlets and switches located on brick walls without channelling. The firm of Strickland & Company recently contracted to wire a large residence in Toronto for some two hundred lights, and in many cases switches and wires had to be located on solid brick wall. They devised a means of overcoming the difficulty and carried out the work successfully. They have baptized the tool used in the work a "persuader," and it is certainly a useful article.

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At the recent meeting of the British Association some very interesting experiments were performed in firing cartridges by means of electric waves, sent out from an apparatus arranged for wireless telegraphy. In this case it was an apparatus similar to Signor Marconi's that was used, and it was intended to have fired the cartridges from a balloon that was sent up from the Lister Park, where the members of the British Association were being entertained, but the balloon got away so quickly that communication was lost with it before the experiments could be carried out, and to satisfy the scientists the gentlemen in charge of the apparatus fired the charges by imitating the wave that would have arrived from the balloon if the communication had been maintained. The arrangement consisted of the usual coherer which is necessary for inductive wireless experiments, and a wave was sent to it through the wooden wall of the hut in which the apparatus was placed, by means of the spark of an ordinary frictional electrical gas lighter. The action of the wave on the coherer caused an electric relay to operate and to connect a battery of accumulators with the wires leading to the fuse, which exploded immediately the current passed. In the opinion of a writer in the Colliery Guardian there are possibilities in this that may be useful in mining.

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At the recent convention of municipal electricians, held in Pittsburg, a humorous communication was read from Mr. L. J. Morgan, formerly city electrician of Kansas City, in which he explained that the office of city electrician in that city had been abolished. Referring to some of the conditions under which the city electrician labors, Mr. Morgan said that "his employers consisted chiefly of the mayor and a city council, or probably the city council and a mayor. Characteristic curves of the mayor may be more or less easily plotted, but no one can foretell the vagaries of the city council. The ethics of the profession," he continued, "demand that dignity should be omnipresent, but dignity and aldermen are strangers. In vain you attempt to discuss with an alderman plans which you have for bettering the electrical condition of the city, or money that you have saved by the elimination of electrolytic electrolysis. The alderman dismisses such a proposition with a gesture and brings you down to earth with a jar by telling you that he has a friend whose door-bell doesn't work or that his electric-light meter is working over-time. If he doesn't want a door-bell fixed or his meter shunted, he probably wants a city telephone placed in his hall or a city arc lamp in his parlor, or perhaps he only wants his gasoline stove repaired. When the influential member introduces you to his brother-in-law and confides to you that he is to be your chief or sole assistant, that he is a first-class kalsominer and in a few days will learn to be a good electrician, you must cheerfully accept this as an axiomatic proposition. Never show the slightest annoyance; if you don't like him take him out and connect him up with the alternating-current primaries. This is not crime, but philanthropy. Endorse unreservedly any and every proposition advanced by any member at any time or at any place. It is also wise to express an eagerness to personally assault any person, not a councilman, who has the slightest views opposed to those of the aforesaid member."

## ELECTRICAL EQUIPMENT OF THE CHAMBLY PLANT.

The initial installation at the works of the Chambly Manufacturing Company, at Chambly, from which point current is transmitted to the city of Montreal, 17 miles distant, consisted of four two-phase generators of 2,000 k.w. capacity each, wound to generate current at 12,000 volts. The plant was so designed, however, as to provide for the installation of eight machines of the above capacity. The demand for power has been such that the Chambly Company have found it necessary to install the additional equipment originally provided for, and we are informed by the Canadian General Electric Company that they have secured the contract for four generators of 2,000 k.w. each to complete the installation. These will be wound for 2,200 volts, and by means of transformers the current will be stepped up to 12,000 volts for distribution over the circuits.

## ELECTRICITY ON GERMAN FARMS.

Under date of August 23, 1900, Consul Hughes, of Cobourg, says: "In this and neighboring parts of Germany, considerable attention is being paid to electrical appliances that can be used on the farm. Near Ochsenfurt, in Bavaria, a company composed of landowners and small farmers has been organized for the establishment of an electrical system for use on their farms and villages. The current is to be generated by steam and water and to be distributed from a central station to the places at which it is wanted. Sub-stations are to be established at given points, with the necessary apparatus for connecting with the farm or other machinery, and also for lighting purposes in the houses, offices, roads and village streets."

The negotiations with Boyd & Company to operate the electric light plant at Huntingdon, Que., by water power have been declared off. The plant will be run by steam until next spring, when steps will be taken by the town to acquire a water power.

# ENGINEERING and MECHANICS

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

FOURTEENTH DINNER OF TORONTO NO. 1.

A jolly party assembled in the large dining room of the Walker House, Toronto, on Thanksgiving eve, to partake of the fourteenth annual dinner tendered by Toronto No. 1, C.A.S.E. The attendance numbered about one hundred and fifty. With one large table at the head of the room and ten smaller tables, prettily decorated with plants and flowers, a splendid effect was produced. Seated at and near the head table were ex-Mayor Shaw, Messrs. James Huggett, president Toronto No. 1; G. C. Mooring, executive president; R. C. Pettigrew, Hamilton, past executive president; Chas. Moseley, executive vice-president; A. M. Wickens, executive secretary; G. F. Haworth, of Sadler & Haworth; J. J. Main, Canadian Heine Boiler Company; G. R. Baker, Westman & Baker; W. C. Powers, traveller Vacuum Oil Company; G. W. Grant, Hamilton-Grant Oil Company; J. M. Sinclair, Eureka Mineral Wool Company; E. J. Philip, The Steam Specialty Company; A. E. Edkins, J. W. Marr, W. P. Sutton, O. P. St. John, W. J. Webb, H. E. Terry, George Thompson, James Bannon, W. C. Blackgrove, Wilson Phillips, and others.

The menu was tempting and served in good style. Their appetites appeased, attention turned to the toast list. As presiding officer, Mr. James Huggett welcomed the guests to the fourteenth annual banquet. In his remarks he pointed out that the engineers were banded together to raise the standard of the profession. This was the sole object of the Association. The secretary, Mr. Marr, read a letter of regret from City Engineer C. H. Rust. "The Queen" being honored, the president asked the guests to rise and drink the health of "Canada, Our Home," to which ex-Mayor Shaw responded in a truly patriotic speech. It was not only the material prosperity of Canada that we should be proud of, but fame had come to our country through the gallantry of the Canadian soldiers in South Africa. He concluded with the remark that our destiny must be with the Motherland.

Mr. A. M. Wickens responded to "Toronto, Our City." Toronto, he said, was the center of the educational institutions of Canada. Perhaps it was not generally known that we have the only free technical school in the world. He, as one who had always taken a deep interest in technical education, hoped that it would soon be possible to furnish the scholars with free books as well as free tuition, and that the Toronto school would be the forerunner of many technical schools throughout Ontario.

The names of Messrs. G. R. Baker and J. J. Main were coupled with the toast of "The Manufacturers." Mr. Baker said that when we look back we must admit that the manufacturing industries had improved within the last four years. He was not one who believed that the introduction of new machines and ideas would decrease the demand for labor. When he started in business they had no planing machine, but used the hammer and chisel. He said that as good mechanics could be found in Canada as anywhere in the world. In calling upon Mr. Main, the president referred to him as one always ready and anxious to help the engineers. Upon rising Mr. Main was heartily applauded. He said that it had been his privilege to be present at eleven of the fourteen banquets which had been held by Toronto No 1. It was also his good fortune never to have had bad times. His trouble had been more work than he could possibly turn out. Recently he had received enquiries for machinery from all parts of the Dominion. Boiler-making, he said, had undergone wonderful changes. A few years ago, when the riveting machine was introduced into the boiler shop, the boiler makers threatened to strike; later pneumatic machinery was introduced, but still there was plenty of work for the men. In his opinion no capable boiler-maker need be out of employment. Mr. Main in closing acceded to a request for a story, the telling of which was roundly applauded.

"Educational Interests" was acknowledged by Mr. E. J. Philip and Mr. A. M. Wickens. The C.A.S.E., Mr. Philip said, had done more to educate its members than any other society. It was the intention of Toronto No. 1 to hold open meetings during the coming winter, at which instructive papers would be read. Mr. Philip referred to the fact that the stationary engineers were in a large measure responsible for the establishment of the technical school. While a course in the technical school was to be commended, another source of education which gave good results was the correspondence schools. A Canadian correspondence school had been started and would be in good running order before the end of the year, and the intention was to cater largely to the needs of engineers. The advantages of this method of education was that students did not require to leave their homes at night, and that older men, who might not be in a position to keep up with the younger students in a class, could regulate the course to suit their ability. Mr. Wickens, in responding, gave a brief history of the objects of the association. There were two associations, the Ontario Association and the Canadian Association. The former is incorporated by the Government to grant certificates to competent engineers, while the latter aims to educate the engineers so that they may obtain these certificates. During the coming year it was proposed to take a further step in educational work. Last year five different lesson papers were issued to active members only, but at the last convention funds were set apart to get out 1,000 copies per month, for twelve months. The object of the papers was to teach engineers how to handle their plant economically. The papers would take up such subjects as water, steam, gases, combustion, temperature, etc., and would be distributed to members and other engineers through the proprietors of steam plants. In this way steam users would get educated regarding the work of the association. Mr. Wickens urged engineers to endeavor to improve themselves, pointing out that there was plenty of room in the engineering trade at the top.

In responding to the toast of "The Executive" Mr. Mooring pointed out that the motto of the Association was safety, reliability, economy, and intelligence. He said that at the last session of parliament they were promised that the legislation asked for would be granted next year. Ald. Pettigrew, of Hamilton, made a brief speech in reply to the same toast. He was pleased to say that the association was growing, and that the Hamilton association, since the last executive meeting, had taken in half a dozen new members. Mr. Chas. Moseley paid a high tribute to Mr. Henry Carscallen, M.P.P., of Hamilton, and Mr. Thos. Crawford, M.P.P., Toronto, for the assistance which they had given the engineers in their efforts to secure legislation.

Mr. O. P. St. John and Mr. A. E. Edkins responded to "Sister Societies," and Mr. James Huggett to "Toronto No. 1." Mr. Huggett stated that open lectures would be given in Engineers' Hall, 61 Victoria street, every third Wednesday in each month, and he extended an invitation to all engineers to attend them. The Association had a good library and was working earnestly to improve the standard of the engineering profession. "Our Host" and "The Press" being toasted, the proceedings of the evening ended.

MR. JAMES HUGGETT,
President Toronto No. 1, C. A. S. E.

An excellent programme of songs was furnished by Messrs. Gillogly, Maguire, Anderson and Trowman.

The dinner committee consisted of Messrs. Jas. Huggett, J. W. Marr, W. L. Outhwaite, W. J. Webb, S. Thompson, Jas. Bannon, A. M. Wickens, H. E. Terry, John Fox, A. A. Storer, and G. C. Mooring.

### MR. JAMES HUGGETT.

Mr. James Huggett, president of Toronto No. 1, was born at Chatham, Kent, England, and at the age of fourteen years entered the Royal Navy Dock yard at that place, remaining there until he reached the age of twenty-one, when he left for Canada. He has resided in this country ever since, and has occupied several important positions in steam engineering. For twelve years he was in the employ of A. S. Whitting, of Oshawa, leaving there ten years ago to accept the position of chief engineer and mechanical superintendent for the Freehold Loan & Savings Company, whose office building at the corner of Victoria and Adelaide streets is one of the best equipped in Canada. A short time ago the Freehold Loan & Savings Co. was amalgamated with the Canada Permanent & Western Canada Mortgage Company. Mr. Huggett, however, retained his position, and in addition became mechanical engineer of the various buildings controlled by these amalgamated interests. Mr. Huggett has always taken an active interest in the work of the Canadian Association of Stationary Engineers, and his election as president of Toronto No. 1 is a well deserved honor.

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The British American Corporation, who are operating their mines electrically, have placed a contract with the Canadian General Electric Company for a 100 h.p. induction motor. This is in addition to several large motors previously installed. The C.P.R. smelter at Trail have also purchased a 150 k.w. motor.

# ELECTRIC RAILWAY DEPARTMENT.

## STORAGE BATTERY—ITS USE ON SMALL ROADS.

By E. B. Van Nostrand.

The application of storage batteries to the generating system of large electric roads has been described by many engineers in a variety of ways, so that an impression has been left upon many minds that it is only with these larger systems that the battery scheme is feasible. This idea is incorrect, and I think that the following description of the equipment and operation of the Peekskill Lighting and Railroad Company will bear me out in the statement. In the description of this road we shall see conditions that apply in a general way to most small lines.

This road was placed in operation in June, 1899, since which time it has been running without any interruption except momentary stops caused by the circuit breakers flying out. Beginning at the station of the New York Central Railroad, which is at the western edge of the town, near the Hudson river, the road proceeds in a practically straight line through the center of the town and on to Lake Mohegan—a total distance of 4¾ miles. The road is an exceptionally hilly one, in fact the fairly level portions are the exception, and are never more than 1,600 feet long. Beginning at the New York station terminus, the road, as far as grades are concerned, is about as follows: Starting into town, there is 1,000 feet of 7½ per cent. grade—with a small portion (say 20 feet) where it reaches 9 per cent. For a distance of about 4,000 feet beyond this, there is a gradual grade, varying from 5½ per cent. to 2 per cent., terminated by 300 feet, of 5½ per cent. to 7½ per cent. At the top of this is a short level, leading into a 2,000 feet 2 per cent. incline, followed by 1,600 feet, varying from 4½ per cent. to 8¾ per cent., which is in turn followed by 2,000 feet of 3¾ per cent. of up-grade. There is after this a depression, represented by 1,400 feet of down-grade, varying from 6.8 per cent. to nothing, which, after passing into a short level rises 1,400 feet up-grade with a maximum of 4.6 per cent., to another short level. Then follows another down-grade of about 1,800 feet, varying between 8 per cent. and 2 per cent. This is followed by 1,600 feet of level—terminated by 300 feet of 8 per cent. After this is 1,000 feet of level, passing into a short down-grade of 6 per cent., 1,300 feet of level is after this, passing into 2,000 feet of 7½ per cent. The final portion to the end of the road is about 800 feet level.

On this entire line of single track, with four turnouts, 56-lb. T-rails are used throughout, these being laid in the usual manner.

There is a single-track branch 4,000 feet long extending from the New York Central station north to the State Camp Ferry. This operates but one month of the year, at which time two cars are in service.

The overhead construction of the system is simple—consisting of 00 trolley throughout, with 0000 feeder, extending to within ½ mile of the lake end and 1,000 feet from the station end. The branch has no feeder. The 0000 feeder is tapped at regular distances throughout its length.

The apparatus for operating the road consists of one 60-k.w. Edison bipolar 575-volt, 880 r.p.m. generator, belted to a horizontal 13-in. x 12-in. Armington & Sims simple engine, the horsepower of which is about 100 at 575 r.p.m. Belted to this same engine, in tandem with the dynamo, is a four pole differential booster, which is used to render the charging and discharging of the battery automatic.

There is another unit consisting of a Westinghouse 120 k.w., multipolar 625 r.p.m. generator, belted to a vertical 14-in. and 24 in. x 14-in. Westinghouse compound engine of 200 h.p. capacity. It may be added here that this generator is rarely used, and that only when the road is unusually heavy—such as occur on holidays and warm Sunday afternoons. The same engine which operates this generator is also belted to one of the alternators for incandescent lighting. It may be well to note that in addition to the above engines there are three other engines which operate the remaining light machines. These, of course, have nothing to do with the railway system. In the boiler room are three 80 h.p. and 100 h.p. horizontal return and tubular boilers, carrying steam at 105 pounds pressure. During the summer months two of the 80 h.p. engines are sufficient to run the entire plant—though three become necessary in winter.

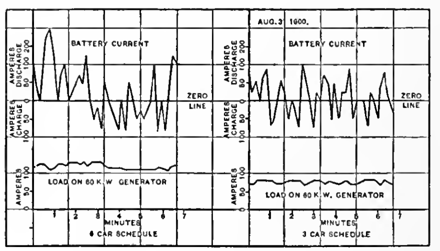
The battery, which is in the simple wooden shed next the boiler room, consists of 26 type F-9 chloride accumulator cells. Each cell is comprised of nine plates, 10½ inches square, suspended in glass jars of sufficient size to enable the capacity to be increased in future by the addition of more plates. Each cell is mounted upon a wooden tray filled with sand, to ensure an even foundation for the jar. These trays rest in turn upon glass insulators, supported by a wooden battery rack. On full charge the battery has a maximum rated capacity of 160 amperes for short periods. As a matter of fact, however, it is often called upon to discharge at a considerably higher rate than this, 250 amperes being called for momentarily.

During the summer season three cars are run from 6 a.m. to 12 p.m. Two of these run through Peekskill as far as the car house at the eastern edge of the town. The other car runs through the town and on to Lake Mohegan. This gives a twelve-minute schedule in town, and forty-eight minutes through to the lake. In the afternoon and evening four cars are run, giving a twelve-minute schedule in town and twenty-four minutes through to the lake. On holidays, etc., five cars are run, all going through—thus maintaining a twelve-minute schedule throughout the run.

Paper read before the New York State Street Railway Association, Buffalo, Sept. 18, 1900.

Having gained a fair idea of the nature of the system, we will pass to the results obtained in the station.

The point of first importance is the remarkable constancy of the load upon the generator, and the correlated fact that the 60 k.w. machine is all that is necessary to operate the road, except when running the five-car schedule. The curve marked No. 1, in the engraving will explain this. This shows the results of ten-second readings, taken upon the battery and generator during a short portion of a four-car run. The total line current is, of course, the summation of these two. It is seen that this total current fluctuates between 25 amps. and 310 amps., and that the generator runs along at practically full and constant load—the battery assuming the fluctuations above and below this. Curve No. 2 shows the same results for a three-car run. Here the average or generator load is lower (about 75 amps.), and the line fluctuates from 0 amps. to 170 amps. The practical good of this is evident. It means that a 60 k.w. machine is running instead of 180 k.w., which would be required were the battery not in service. In other words, although the load fluctuates from almost nothing to 180 k.w., the average is in the neighborhood of 60 k.w., and it is this average only which falls upon the generator and engine. The remarkable evenness of the load upon the generator produced by the operation of a storage battery is shown very nicely by the fact that we are operating our 120-k.w.




No 1. No. 2,

railway machine and one of the alternators for our electric lights from the same engine. Ordinarily this would produce a very serious flickering in the lights, but in our case it is impossible to detect the slightest change in the brilliancy of the lamps, although the railway may be fluctuating between its widest limits. I have not had an opportunity to test the coal saving produced by this arrangement, but I am confident from my observations that it is sufficient to pay a good return upon the battery investment over and above the interest and depreciation charges.

The increased economy of a small unit operating at a full and constant load above that of one three times the size, but doing the same work under highly fluctuating conditions, is such as to warrant this assumption.

It would be difficult to increase the simplicity of operation in this plant. After the original adjustment, the apparatus has worked together without the slightest difficulty. We have a generating unit operating under electric lighting conditions, due to the fact that the battery removes from the systems all sudden overloads, and the strain thus removed from the minds of those in charge is in its effect almost as valuable as this latter consideration.

In other ways the battery is valuable. A great many times it has been necessary to shut down the small engine suddenly from some mishap. During the eight or ten minutes necessary to get the other unit into operation the battery has carried the entire load.

Then, too, it is often desirable to run a car for some special occasion very late at night. At such times the generator is shut down and the battery thrown across the line.

In conclusion, I may state that the battery has given us absolutely no trouble since its installation, and the daily labor for its proper care does not average more than one-half hour. In fact, about all the work required is that of taking voltmeter and hydrometer readings upon the individual cells once each week.

## THE MONTREAL STREET RAILWAY.

The fortieth annual meeting of the Montreal Street Railway Co was held in Montreal on November 7th. The report of the directors of the past year's business showed a net profit of $647,-246.64, as compared with $630,870.61 for the previous year. The operating expenses, it was stated, showed an increase of 1.11 per cent. as compared with last year, this increase being due to more frequent and extended car service, increased expenditure for snow clearing, and increased cost of fuel and general supplies, as well as labor.

The company's rolling stock was increased during the year by the addition of 56 closed motor cars, 45 open motor cars, one stores car, 7 supply cars, and 80 trucks, while 128 motors and 83 controllers were added to the electrical equipment of the cars. There are at present under construction in the company's shops six extra long closed motor cars, mounted on double trucks, making in all 25 cars of this type which will be available for service this winter.

The system of cast-welding rail joints was continued and extended, the experience obtained during the past two years fully justifying the expense incurred.

## TRADE NOTES.

We have received from Messrs J. E. Rhoads & Sons, of Philadelphia, a handsomely printed and illustrated catalogue of one hundred pages, descriptive of their leather belting and factory fire extinguishing appliances, etc.

Mr. L. Sapery, of the Syracuse Smelting Works, Montreal, who has recently returned from Europe, reports that he has secured some good orders for their celebrated babbitt metals and Columbia phosphor tin in England and France, which will be filled for the first time from the Canadian works. This the first instance of babbitt metal or phosphor tin being imported from Canada.

## SPARKS.

It is stated that the Electric Development Company, of Philadelphia, will open a Canadian office in Hamilton.

The Chambly Electric Company, of Montreal, have installed a 5 h.p. motor to run a 5 ton capacity elevator in the warehouse of F. X. Benoit & Co., flour merchants, Montreal.

The Aylmer Electric & Manufacturing Company are installing a new 3,000 light incandescent generator purchased from the Canadian General Electric Company, being one of their latest type revolving field machines.

The Chambly Electric Company, of Montreal, have received an order from C. O. Beauchemin & Fils to install a complete warehouse telephone system of ten instruments in their warehouse and seven in their printing office. An aerial cable 5000 feet in length will be used between the two establishments.

It is reported that the American Bell Telephone Company, the Telephone, Telegraph & Cable Company of America, the Western Union Telegraph Company, and the Postal Telegraph-Cable Company will be consolidated into one big company, to be known as the National Telephone & Telegraph Company.

The electrical equipment of the church of Maisonneuve, P. Q., has gone through many changes. Originally a few lamps were put in, but, considering the advantages of electric light, the churchwardens decided to have a complete plant installed for lighting the entire church. Mr. Valois, manager of the Chambly Electric Company, of Montreal, secured the contract for the installation of a 200 light plant, which was completed in September last.

The Toronto Railway Company have for some time been manufacturing controllers after a patent claimed to be owned by the Canadian General Electric Company. The latter brought suit against the railway company to restrain them from manufacturing the controller, and the courts gave judgment in favor of the plaintiffs, and ordered defendants to pay all costs. The controllers now in use on the road will be continued on payment of damages which have been agreed upon.

The corporation of Lachine, Que., has owned and operated its own electric lighting plant for seven years past. Recently, however, it became dissatisfied with this method, and, after having consulted with Mr. R. A. Ross, consulting electrical engineer, decided to dispose of the plant and accept the offer of the Lachine Rapids Hydraulic & Land Company for the necessary supply of current, which will be delivered at the transformer primaries. The distribution system will be entirely remodelled and adapted for the use of alternating current for light and power.

The Electrical Construction Company, of London, Limited, find their business expanding and growing to such an extent that they have deemed it advisable to enlarge their premises and equip their factory with the latest modern improvements for facilitating the economical and convenient handling of their machinery. They have purchased lots No. 32, 34, 36, 38 and 40 Dundas street west, opposite the court house, 200 feet deep, on which they are erecting a three-story factory. This company have recently extended their business to include fixtures, house wiring, and general electric supply trade, together with several specialties of foreign manufacture. They will, in their new factory, be prepared to handle light and power generators of all sizes and of all requirements. Their factory is being built according to the plans of the so-termed modern machine shop, having travelling crane covering the entire shop, and galleries on each side for the lighter work; the main floor being used for the heavy tools and handling of heavy work. They will be in a position to turn out the very best high grade machinery at a minimum of cost.

## SPARKS.

Mr. P. Scanlan has been appointed engineer in the new electric light station in East Toronto.

The New Brunswick Telephone Company purpose erecting a new telephone exchange at St. John, N.B.

Nerlich & Company, of Toronto, are installing a 25 k.w. direct connected generator of the Canadian General Electric Company's type.

Wm. Gray & Sons, carriage builders, of Chatham, Ont., are installing a 350 light plant supplied by the Canadian General Electric Company.

It is proposed to build an electric tramway from Nanaimo, B.C., to the Extension Mines, five miles distant. The road is estimated to cost $150,000.

The plant of the Simpson Knitting Company, of Toronto, referred to in last issue, will include a 500 light direct current Canadian General multipolar generator.

Warden Evans, of Lincoln county, recently headed a deputation which asked the Provincial Government for a charter for an electric railway from Niagara to Port Dalhousie and Queenston.

The shareholders of the Hamilton, Grimsby & Beamsville electric railway have decided to apply to the Legislature for authority to extend their road to St. Catharines, Niagara and Niagara-on-the-Lake.

The Wright Taper Roller Bearing Company is a new Montreal concern applying for a Dominion charter, to manufacture a patent roller bearing for railway cars, bicycles, etc. Mr. W. H. Laurie, of Montreal, is interested.

The Dominion Coal Company, of Sydney, C.B., have contracted with the Canadian General Electric Company for three generators, direct connected to Ideal engines manufactured by the Goldie & McCulloch Company, of Galt.

The Von Echa Company are building an electric railway between Ingersoll and Woodstock, Ont., and have purchased their railway equipment from the Canadian General Electric Company, the intention being to use G. E. 1,000 motors.

Geo. Smith, an electrician of Galt, was killed at Lindsay on October 24th while engaged in the installation of a fire alarm system. Deceased had cut a guy wire, which fell across a live wire, and attempted to remove the guy wire with his naked hands. Instant death resulted.

The Westinghouse generators in the power house on the Canadian side of Niagara Falls were set in motion a fortnight ago. Their capacity is 30,000 horse power. The belts for same were supplied by Sadler & Haworth, of Montreal and Toronto, and include several 44 inches and 24 inches wide, and a number of smaller sizes, each about 100 feet long.

The surveys and plans for the proposed electric railway from Niagara Falls to Fort Erie on the Canadian side have been completed, and preparations are being made to proceed with construction this winter. The road will be constructed along the water's edge, will be 20 miles long and built for fast service. Mr. C. H. Mitchell, Niagara Falls, Ont., is engineer.

The Department of Justice at Ottawa are installing a lighting plant in the St. Vincent de Paul penitentiary. The electrical equipment will be supplied by the Canadian General Electric Company and will consist of one 30 k.w. and one 75 k.w. direct current direct connected generators and a three panel switch-board. The power equipment will be one 50 h.p. high speed simple engine, one 120 h.p. high speed tandem compound engine, and two 75 h.p. boilers, supplied by the Waterous Engine Company, of Brantford.

At the last meeting of the Stamford Township Council Mr. Joseph Battle, of Thorold, asked that the Niagara, St. Catearines & Toronto Railway Company be granted the privilege of building a spur line from a point near the main line and the Stamford–Thorold township line to the Thorold stone quarry. The line will be about two miles in length, and will cost about $9,000. The purpose of the road is to carry stone from the quarries to the main line of the Niagara, St. Catharines & Toronto Railway. It is proposed to be operated by electric locomotives.

An interesting application of electricity for industrial purposes is found in the operation of the plant of the Ottawa Carbide Company at Ottawa. The electrical apparatus was manufactured and installed by the Canadian General Electric Company. A description of the plant would, no doubt, prove interesting to our readers, but this is impossible at present owing to the refusal of the company to allow outsiders to inspect the works. The reason given is that the machinery is said to embody several valuable improvements which have not yet been patented, and new processes in connection with the manufacture of carbide that are known only to the principals of the company. The works are estimated to have cost half a million dollars. Mr. Frank Creelman, C.E., is the consulting engineer.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. X. DECEMBER, 1900 NO. 12.

## ELECTRICAL EQUIPMENT OF McDONALD ENGINEERING BUILDING AT McGILL.

THROUGH the munificence of Sir W. C. McDonald, the authorities of McGill University, Montreal, have been enabled to erect and equip a building for the study of engineering which is one of the most complete institutions of the kind in America. Of pleasing architecture, the exterior is at once admired, while the interior arrangements and equipment command equal praise. The electrical equipment of the McDonald Engineering Building, as it is called, was described at some length in the ELECTRICAL NEWS of May, 1898, but since that time extensive alterations and additions have been made, as will be seen from the following particulars and accompanying illustrations of the equipment as it now stands :

The power station, the heart of the institution, is well shown in the illustration on this page. In this room all the electric power is generated which is used in the building for lighting and power and for the laboratories and test rooms. It differs in one important particular from a power house for purely commercial purposes, inasmuch as there has been no attempt at standardization in the units adopted as regards the type, the reason obviously being that it has been considered advisable to bring under the notice of the student as many different types of apparatus as possible. Consequently, side by side will be found a Robb-Armstrong engine driving a 75 k.w. direct current 110 volt Crocker Wheeler generator, while opposite is seen a similar size Ideal engine, by Goldie & McCulloch, driving a 75 k.w. Canadian General Electric Company's machine of the same voltage.

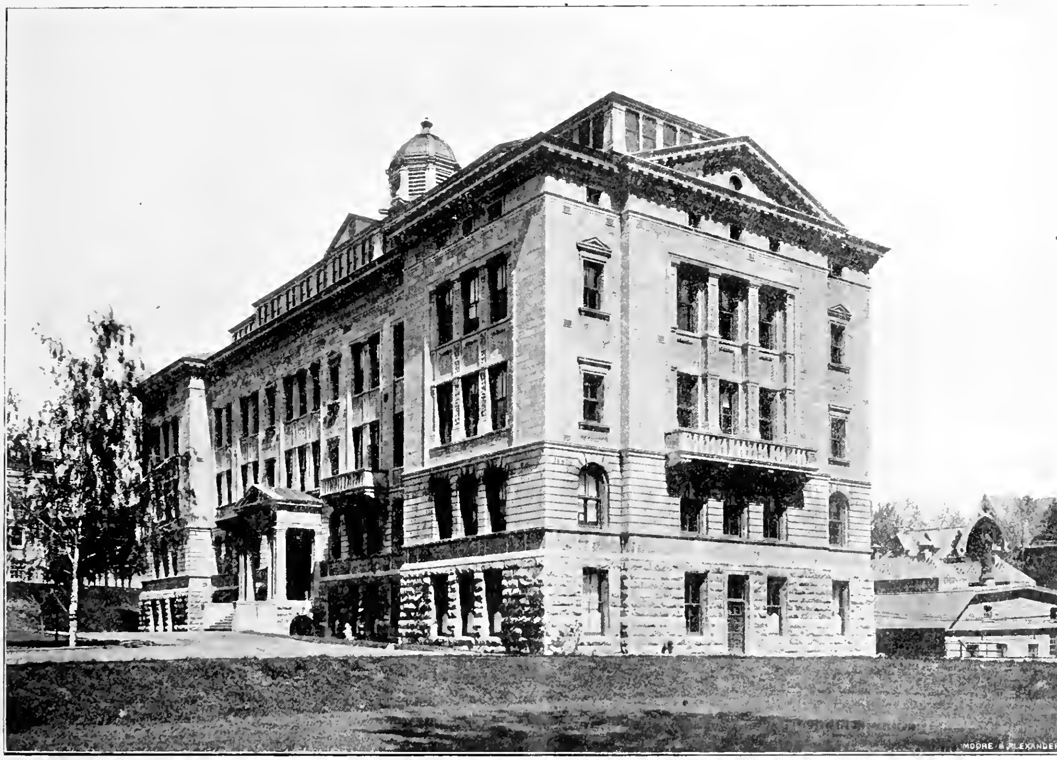



FIG. 1—McDONALD ENGINEERING BUILDING, McGILL UNIVERSITY, MONTREAL.

Great Britain is represented by two Willans engines driving a Siemens and a Mather & Platt direct current 30 k.w. 110 volt machine respectively. All or any of these machines may be used for either lighting and power for the general uses of the building, or for the laboratory testing purposes, through a four panel switch-board.

In addition to the above, a storage battery has been installed for the purpose of lighting the building when the plant is not running, and for charging purposes a Sprague motor generator is used to raise the voltage about forty volts over the 110 volts of the dynamo plant. The absence of wires is noticeable, all wires and cables being carried in ducts under the tessellated floor, but as these ducts are covered by iron plates they are as readily accessible as if exposed in the unsightly manner so often adopted. In short, the well lighted, airy, clean power house with all necessary appliances, but without any gingerbread fittings for show, is a model of what such a plant in an educational institution should be.

Probably the most important part of the laboratory which is intended for the education of practical engineers, is what is called the commercial laboratory, and it is well named, for not only are all classes and types of machines here gathered together, but are noticeably arranged for commercial work in the most practical way. The test room of a manufacturing establishment, and the usual college laboratory, are generally very dissimilar; the one bearing evidences of the hasty and unscientific methods which are apt to prevail in a commrecial establishment, while the other very often partakes of the nature of a scientific kindergarten. In this case, the arrangements for good practical engineering work are unsurpassed, not only by reason of the great amount of apparatus, but notably by reason of the thoroughly practical way in which the work can be carried on. For instance, each test can be operated independently of any other without that confusion which would inevitably result from an improper and unpractical lay-out of the apparatus, while flexibility of the apparatus is increased to the maximum by the ease by which the machines may be moved from place to place by the travelling cranes and the facility of connection to the circuits, which run in easily accessible channels under the raised floor upon which the machines are set. This floor being equipped with slots and plugs like an iron planer table, is suitable for the base of any machine, and also ensures that the belts may be kept tight without unsightly and cumbersome tightening apparatus. Movable tables of solid construction are provided upon which can be mounted the necessary local instruments and switches which may be found necessary for any particular test which may be undertaken.

As will be seen by the illustrations (Figs. 3 and 4) this laboratory is divided into sections called the alternating current room and the direct current room. While really the same room, these names are adopted to indicate the classification of the apparatus, for on the one side the alternating current dynamos driven by direct current motors are placed, while on the other the direct current generators and arc machines are set, and as each of these sections has its own travelling crane, cables switches, etc., the two divisions of the laboratory are independent. The alternating current laboratory containing, as it does, examples of the best types of single two and three phase machines, as well as special apparatus for phase and periodicity changing, is probably the more interesting of the two, while the direct current laboratory contains types which are familiar by long association to any one acquainted with the average lighting and power station for commercial purposes. It may be noted that while the size of the machines is not such as to command attention, the largest unit not exceeding 40 k.w., none of them are toys, but of a size sufficient to demonstrate the peculiar features of each type, and are arranged and connected so that the distinctive features of each may be best shown. A glance at the principal pieces of apparatus will illustrate this fact, for we find driven by appropriate variable speed direct current motors the following types :

A 15 k.w. alternator, with revolving fields, made

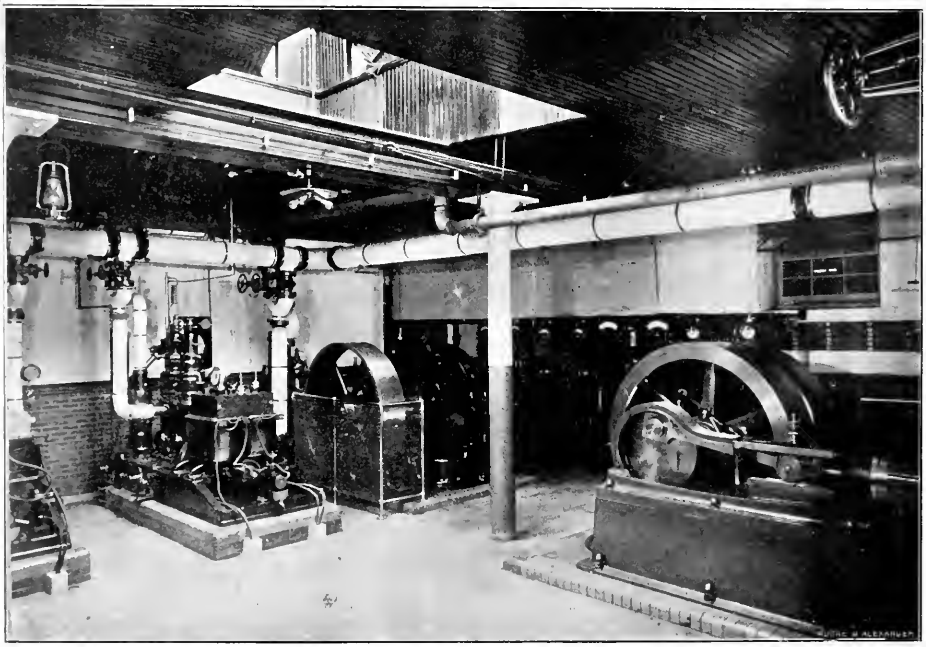


FIG. 2.—GENERATOR ROOM, MCDONALD ENGINEERING BUILDING, MCGILL UNIVERSITY.

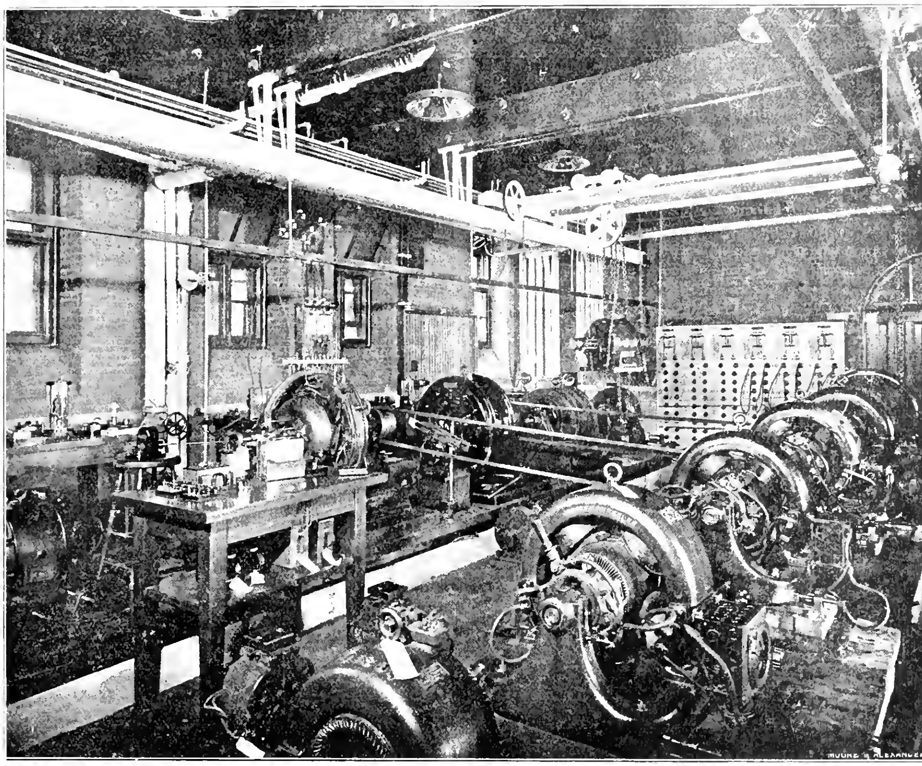


Fig. 3.—Alternating Current Dynamo Room, McDonald Engineering Building, McGill University.

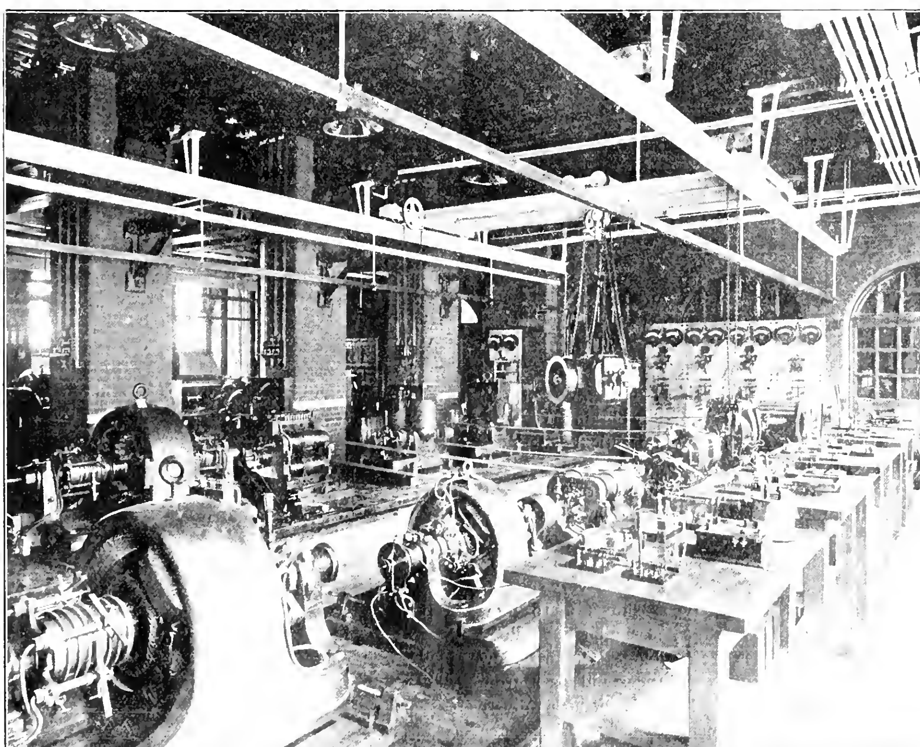


Fig. 4.—Direct Current Dynamo Room, McDonald Engineering Building, McGill University.

by the Canadian General Electric Company which may be used for either single two or three phase operation; a 15 k. w. Stanley two phase alternator, made by the Royal Electric Company, which illustrates the inductor type with stationary armature; a 15 k. w. Warren inductor alternator, for single phase operation; a 12 k.w. Hordey inductor alternator made by the Brush Company; a 20 k. w. one, two or three phase double ended Westinghouse rotary converter, and two others of the same type of 10 k. w. each; a 10 h. p. two or three phase induction motor made by the Canadian General Electric Company, arranged for frequency changer through the variable speed of the driving motor.

In addition there are a number of alternating current motors from two to five h. p., as well as the direct current motors used for the generator drives, which vary from ten to forty h. p., of General Electric and Crocker Wheeler type. The instruments and accessories which which will abundantly satisfy the most enthusiastic student, especially when it is noted that the power station and all the laboratory motors are also of the direct current types.

In addition, there is being installed at the present time a Chloride storage battery of 75 k.w. hour capacity, which is arranged to float on the circuit supplying the laboratory, which absorbs current when the load is light and gives it out when the laboratory demands are great. This battery will thus not only aid the regulation, which is so important where experiments are to be successfully carried out, but will be available for standardizing instruments and similar work where a very steady voltage is required.

The ampere meters, volt meters, condensers, transformers, voltage regulators, electric speed indicators, dynamo meters, etc., are of too great a variety to enumerate, and the resources of European and American

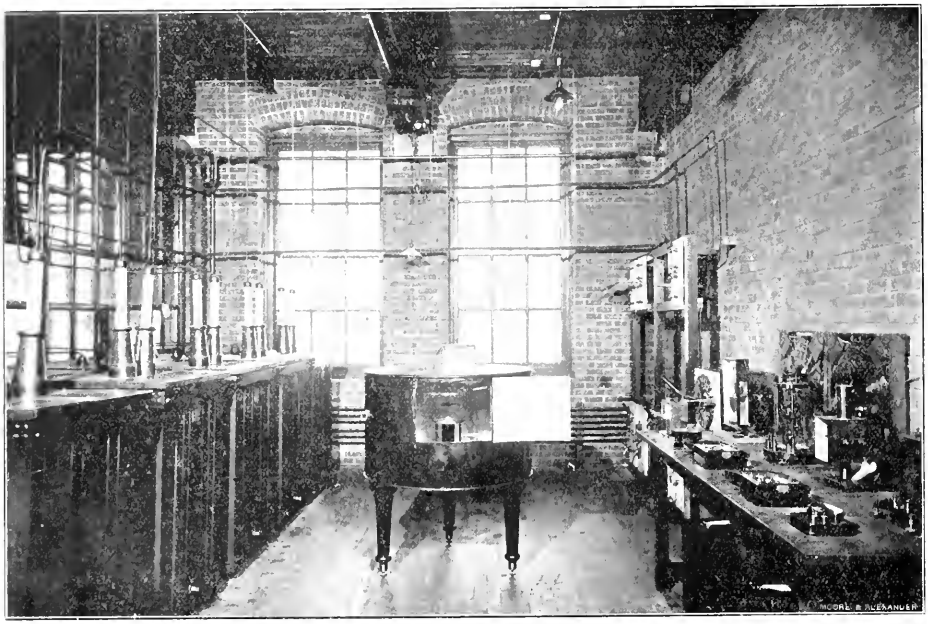



FIG. 5.—HIGH TENSION LABORATORY, McDONALD ENGINEERING BUILDING, McGILL UNIVERSITY.

must of necessity be used in the work are of every variety and of representative types, and include a number of special instruments of precision not usually found in the laboratory. With the above equipment it becomes easy to meet any case which may arise, and power of any periodicity, phase or voltage is readily obtainable. It is here that the student gets his most practical experience in dealing with alternating currents.

The direct current laboratory, while representative of the older and more similar types of machines, will not demand from the student that study which he will have to devote to the alternating section, but as representing direct current machinery and practice it is very suitably fitted up. A glance at the types shows a 16 light Thompson Houston arc machine, a similar size Wood arc, and a ten light Brush arc machine. Of direct current motors there are many of all types and sizes from one-twentieth to 15 h. p., the latter size being a railway motor. These, with their numerous accessories, such as rheostats, switches, arc lamps, starting boxes, etc., allow of a scope for experiment in direct current field makers have been drawn upon in the largest way to make the auxiliary apparatus complete.

With this commercial laboratory so thoroughly equipped, Professor Owens has at his disposal an instrument thoroughly suitable not only for instructive purposes but also for the commercial testing of lamps, transformers, meters, etc.

The high tension laboratory, with its transformers wound as high as 30,000 volts, its electrostatic instruments for measuring pressures of 150,000 volts, with accessories in the shape of meters, regulators, impedence coils, etc., is evidently no place for the freshman of an investigating turn of mind. It is here that all high voltage experiments are carried out, line insulators tested, and completed apparatus subjected to the searching thrusts of thirty thousand volts or so. To the high potential laboratory is due the advances in insulation which have made it possible to transmit power to long distances at high voltages, and it is this department which will be called upon in the future to extend the range of commercial voltages, so that this will be a more important department in the future than seven at the present time.

The standardizing laboratory, where all instruments are calibrated and the most of the high class experiment-

al work is done, is well shown in Figure 6. Here very accurate measurements of voltage, current capacity, self induction magnetization, etc., are made, and it is here that the student receives his training in the use of instruments which should enable him to carry on the work of original research. In this department are to be found standard Kelvin balances for the measurement of current up to 600 amperes, either direct or alternating, electrostatic and multicellular voltmeters up to 10,000 volts, designed by the same eminent scientist; Thomson and D'Arsonval galvanometers, standard cells, wheatstone bridges and potentiometers, standard resistances, and a multitude of standard voltmeters and ampere meters. For the testing of irons there are permeability bridges and hysteresis meters designed by Ewing, and special transformers, phase shifters, rheostats and condensers in formidable array complete the more important apparatus. This is the final court of appeal before which all hysteretic and impermeable irons receive their sentences; here are dragged all untruthful and perjured ampere and volt meters to have their characteristics examined and their faults corrected.

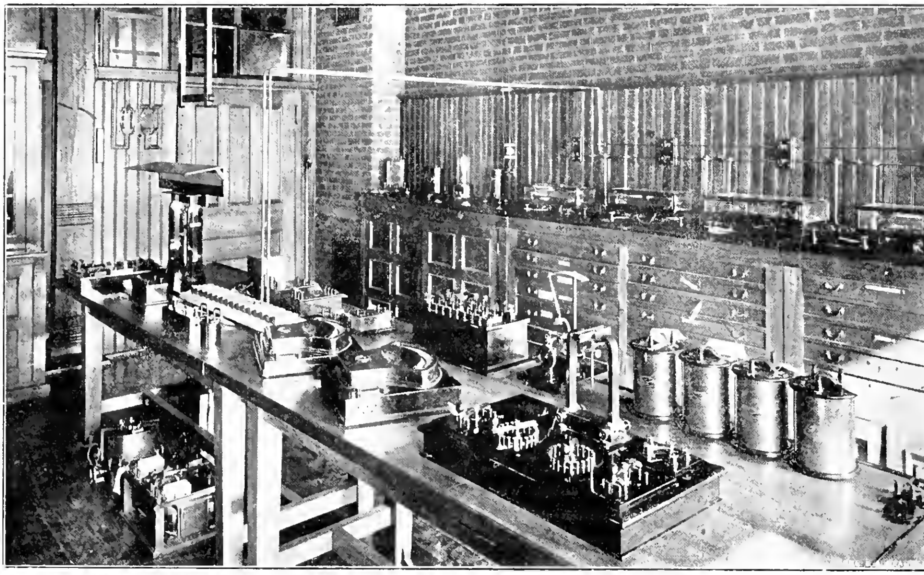


FIG. 6.—STANDARDIZING LABORATORY, McDONALD ENGINEERING BUILDING, McGILL UNIVERSITY.

From the standardizing laboratory the student reaches the original research laboratory, where in his later years he is given a free hand to investigate for himself certain promising fields for which his previous training has fitted him. Several special instruments are here placed, but the greater portion of those here used may be drawn from the other departments as required. In addition we should mention the shops where skilled mechanics repair and construct special apparatus for the use of the laboratories.

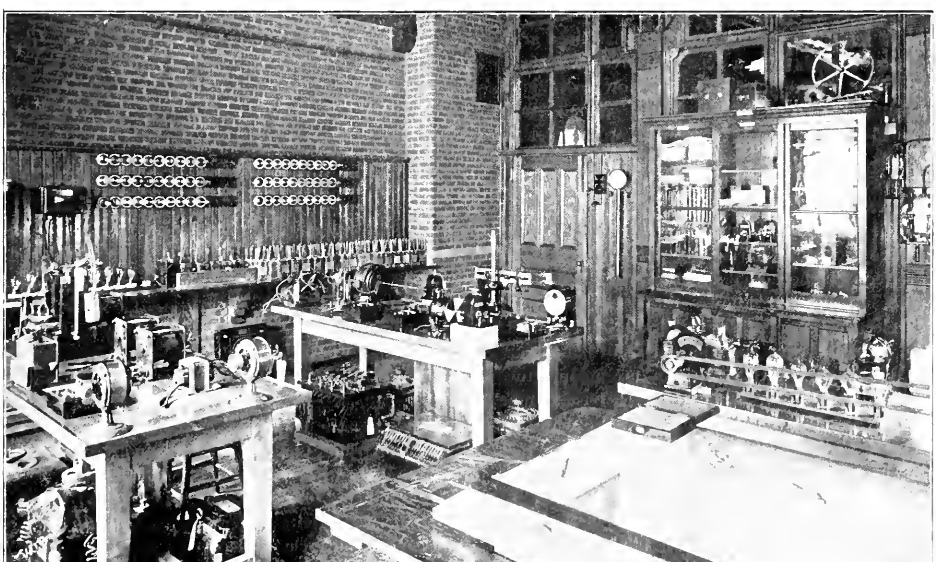


FIG. 7.—SPECIAL INVESTIGATION ROOM, McDONALD ENGINEERING BUILDING, McGILL UNIVERSITY.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2290.

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The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

**The Growth of Electrical Engineering.**

REFERENCE was made in our last issue to the large number of fourth year engineering students at McGill University who are taking the electrical engineering course, the proportion of such students being sixty per cent. of the fourth year men. We learn on subsequent enquiry that at the School of Practical Science, Toronto, a still larger proportion, namely, 62½ per cent. of the senior students, are taking the course in electrical engineering.

**A Misrepresentation.**

The ELECTRICAL NEWS has been advised that a representative of a certain trade journal who is now travelling in Great Britain has represented to British manufacturers of electrical supplies that there is an enormous field for their goods in Canada. As a consequence, advertisements have been placed in the said journal, and the representative in return has furnished to the British manufacturer the names of Canadian supply houses, to whom letters have been sent offering electrical goods. It is to be regretted that the actual situation should be misrepresented. It is well known that the demand for British electrical goods is exceedingly light in this country. Take, for instance, incandescent lamps; the bulk of those used in Great Britain are manufactured outside of the country, while the T.H. base so much used here is practically unknown there. So with sockets. Owing to their using more keyless than key sockets, the shades are generally not arranged for a holder, but with a hole in the centre, the same as for the Edison old style systems here. The difference between wire gauges here and in Great Britain is likely to result in errors occurring in orders, as the buyer here is more accustomed to the B. & S. than to the B.W.G. Considering the population, there is indeed a large consumption of electrical goods in Canada, but before British firms can secure a reasonable share of the trade it will be necessary to introduce a number of important changes in manufacturing methods. If their goods are manufactured to meet the requirements of the Canadian trade, there is no reason why British manufacturers should not increase their exports of electrical goods to this country, as witness the large quantity of these goods now imported from the United States and Germany. But the persons to properly develop the trade are those versed in electrical matters, while the prospects of business are lessened by the tactics of the journal above referred to.

**A 150-Mile Transmission.**

WITH the immense water power of the Niagara Falls situated about eighty miles from the city of Toronto, the undertaking of the Standard Electric Company, of California, has a peculiar interest for Toronto citizens, and especially at the present time when the necessity of cheaper power for our manufacturing industries is so fully recognized. In the project of the Standard Electric Company we have an object lesson which may encourage the development of Niagara power. It should be stated, however, that in California the cost of coal is much greater than in Ontario, giving a water-power plant there an advantage over steam which would not apply in the case of transmitting power from Niagara Falls to Toronto. The power house of this company is located at Blue Lakes, and for some time electric power generated at this point has been transmitted to Stockton, forty-six miles distant. The ultimate intention is to transmit the power to San Franscisco, a distance of one hundred and forty-five miles, for which purpose a plant is now nearing completion. In addition to being the longest transmission line ever operated commercially, the plant will be distinctive for two other reasons, first, that the current will be transmitted at a pressure of 60,000 volts, which is twice as high as has heretofore been attempted, and, secondly, that aluminum wire will be employed as the conductor. The high voltage employed will necessarily reduce the cost of the transmission line. This is one of the advantages claimed for aluminum as a conductor. The relative merits of copper and aluminum for the transmission of electricity have been much discussed of late, and it cannot fairly be said that the experiments thus far with aluminum have shown it to possess an efficiency equal to that of copper, while its resistance to atmospheric influences is not as great as was at first supposed. The companies in America who have employed aluminum wire are the Snoqualmie Falls Power Company, a 34 miles transmission, with 29,000 volts; North Yuba Power Company, of Sacramento, 63 miles; Hartford Electric Light Company, 11 miles, 10,000 volts; Cottonwood Power Company, of Utah, 12,000 volts; Telluride Power Company, of Provo, Utah, 80 miles; Niagara Falls Power Company, for a short transmission; and the Standard Electric Company above referred to. In connection with the transmission of power from Ragged Rapids to Orillia, Ont., it was originally proposed to use aluminum wire, but for some reason this decision was not adhered to. It would seem that the use of aluminum is yet quite experimental, and that its use may develop obstacles difficult to overcome.

**Prevention of Smoke.**

IN cities where manufacturing is carried on to any extent a question of some moment is the prevention of annoyance from smoke emanating from steam boilers. For three years past a law has been in force in the city of Montreal providing that all steam users must equip their plants with apparatus for consuming the smoke, while a by-law has received its second reading in

the Toronto city council designed to accomplish the same purpose. To the latter by-law exception has been taken by the Canadian Manufacturers Association, and rightly so, as in its present crude form we believe the ordinance to be unworkable. It provides that all manufacturers using combustible material to produce heat or power shall apply such apparatus as shall prevent the smoke from fouling the atmosphere, and in the event of neglecting, they are to be subjected to a fine of fifty dollars for each offence. The objections urged against the by-law are that the method of conviction is such as would place manufacturers entirely at the mercy of unscrupulous persons who might from time to time feel disposed to persecute them, and that the by-law should be more explicit and state what device will satisfy the requirements and exempt a manufacturer creating smoke from liability to prosecution. The difficulty of overcoming the smoke nuisance is well illustrated by the experience of cities in the United States. Although in a number of cities such by-laws as the one under consideration are in force, the results in the main seems to have been unsatisfactory. In Rochester, for instance, such a law was enacted twelve years ago, but was subsequently repealed. In Syracuse it is not considered a success, while in Pittsburg, Cleveland and Chicago it is said to have relieved the trouble only in a slight degree. In these cities the duty of enforcing the law devolves upon the city engineer or some other competent person appointed for the purpose. The strongest objection that can be advanced against the enactment of a law such as that framed by the Toronto city council, is the doubtful merits of smoke consumers. The opinion seems to prevail, based upon experience, that of the various smoke consuming devices on the market none will accomplish the purpose for which they are intended, and it is a question in the minds of manufacturers whether the degree of efficiency to which they have attained will warrant the expenditure necessary for their installation. Tests of smoke consuming devices have been made in Toronto with the result of increasing the cost of operating the boilers, without abating the nuisance. To our mind, the prevention of smoke from steam boilers has more nearly reached attainment than the consumption of smoke. The methods of firing boilers have undergone great changes in recent years. With these changes have come better combustion and a decreased quantity of smoke. The automatic stokers have, we believe, accomplished much towards smoke prevention. We are told that by this method of firing, the O'Keefe Brewing Company, of Toronto, have practically overcome all annoyance from smoke, and at the same time have effected a saving of fifteen per cent. in fuel. The trouble may also be diminished by the erection of higher chimneys, by having sufficient boiler capacity so that it becomes unnecessary to force the boilers, and by the edncation of the boiler attendants. By means of a high chimney a better draft through the furnace is secured. This will assist in relieving the smoke and also effect a saving in fuel. The matter of educating the firemen is one which has received attention in Great Britain, where in some cities the law is such that where the boiler capacity is ample and smoke is allowed to emanate, the fireman instead of the owner is prosecuted for the offence. The Canadian Manufacturers Association have suggested that the city council make a test at the waterworks plant of the various smoke consuming devices, and decide upon one which will meet the letter of the law. This, we think, is placing the responsibility upon the proper shoulders, but we are by no means sanguine that the results accmplished will be satisfactory either to the city council or to steam users, as it seems impossible to select a device that will meet the varying conditions under which different steam plants are operated.

## THE CATARACT POWER COMPANY.

The Cataract Power Company, of Hamilton have been making extensive alterations and additions to their power house, distributing lines and transformer station. Having found it necessary to increase their plant, they have just installed two new 3,000 h p. turbines, manufactured in Milan, Italy, two 2,000 k.w. S.K.C. generators, ten 400 k.w. step-up transformers, three 300 k.w. rotary converters, and a chloride storage battery equipment. They have also built a second transmission line of No. 00 copper wire. A new building is nearing completion which will contain the rotary transformers, arc light apparatus, new battery equipment, and the switch-boards. It is the intention of the company to close down the power houses of the Hamilton Electric Light Company, the Hamilion Street Railway Company, and the Hamilton Radial Railway Company, and to distribute altogether from the step-down station on Victoria avenue, the incandescent, arc, power and railway service being supplied from one building.

The generators recently installed are among the largest yet built in Canada, and, we understand, by weight, the largest in North America. Each generator has a capacity of 2,000 k.w., with a large overload capacity. The weight of the generator complete is over 110 tons, or 220,000 pounds, and is similar in design to the 1,000 k.w. machine two of which the Cataract Power Company now have in their station. The total capacity in generators is over 10,000 h.p. The entire machinery throughout has been supplied by the Royal Electric Company, Montreal, and consists entirely of S. K. C. apparatus operating at two and three phase. This is now one of the most complete power stations in Canada, and is giving excellent results.

## THE CHAMBLY POWER PLANT.

An unfortunate accident occurred at Chambly early in November, when a portion of the Chambly Manufacturing Company's dam adjoining the power house was swept away. The main part of the dam remained intact, but about 150 feet situated close to the shore and used as sluice gates for waste water was destroyed.

The accident is said to have been due to the water loosening the concrete embedded around the gates. The loosening of the concrete had been noticed, and means were about to be taken to strengthen it.

The lighting service was not interrupted to any extent as the result of the accident, as the steam reserve plant retained by the Royal Electric Company was immediately called into requisition.

In connection with the additional plant about to be installed at Chambly, some important changes will be made. The line voltage will be changed from 12,000 to 25,000 volts, and the generator voltage from 12,000 to 2,000 volts. The line will be changed from four wire to three wire transmission. The four new generators to be installed, and which were referred to in last issue, will be 2,000 k.w., 2,000 volt machines, of the revolving field type, while the new turbines will consist of sixteen 51 inch S. Morgan Smith wheels, with possibly Lombard governors. It is also the intention to put in ten 2,000 k.w., 2,000 to 25,000 volt air blast transformers, and to deepen and widen the trail race.

## A BRIEF HISTORY OF THE SCHOOL OF PRACTICAL SCIENCE.

THE banquet to be tendered on December 21st to Professor Galbraith, principal of the School of Practical Science, Toronto, by the faculty, graduates and other graduates, has naturally carried the thoughts of many back to the early days of the school, as almost since its inception the name of Professor Galbraith has been regarded as synonymous with the success of the school. Established in a modest way to meet the demands for technical and scientific education, the growth of the institution has been almost phenomenal, until the increased accommodation provided from time to time is now entirely inadequate.

The present School of Practical Science is the successor of the College of Technology, an institution which was practically an evening technical school for artisans and others, and which occupied the building of the present public library, corner Church and Adelaide streets. The origin of the present school dates from January 30, 1877, when the Legislative Assembly, in accordance with the recommendations of a report to the Hon. Adam Crooks, Minister of Education, by Professor James Loudon, sanctioned the proposal for the permanent establishment of a School of Science, and authorized the erection of a new building upon a site in proximity to the University of Toronto. The character of the institution was greatly changed, and under the new arrangement the chief object of the school became the teaching of engineering and applied chemistry. It was decided, by an arrangement with the Council of University College, to utilize the teaching power of that college which already existed for the like objects in four departments and could be made applicable to the wants of the School of Science, and in addition thereto to appoint a professor of engineering and such assistants as might be found necessary. This arrangement continued until the end of 1899, when the departments of science were transferred from University College to the University of Toronto, under the operation of the University Federation Act. That the students might continue to receive instruction in the above departments in the same manner, the School of Science was affiliated to the University of Toronto.

PROF. GALBRAITH,
Principal School of Practical Science, Toronto.

The building erected at that time forms the north wing of the present school. Besides being the home for the engineering classes, it furnished accommodation for the departments of biology, chemistry, and mineralogy of the University, the engineering department having but one floor.

The first calendar of the School of Practical Science is denoted as the session of 1878-79, and the faculty consisted of H. H. Croft, D.C.L., professor of chemistry; E. J. Chapman, Ph.D., L.L.D., professor of mineralogy and geology; James Loudon, M.A., professor of mathematics and natural philosophy; R. Ramsay Wright, M.A., B.Sc., professor of biology; J. Galbraith, M.A., Assoc.Inst.C.E., professor of engineering; W. H. Ellis, M.A., M.B., assistant professor of chemistry. The attendance at the school in this year was six students.

From the calendar we notice that there was three courses, namely: (1) engineering; (2) assaying and mining geology; (3) analytical and applied chemistry. Regarding the engineering course, it is stated that in the absence of a machine shop visits to workshops and excursions during the long vacation will be taken advantage of.

An important event in the history of the school occurred on November 6th, 1889, when Professor Galbraith was appointed principal and the management of the school entrusted to a council composed of the principal as chairman and the professors, lecturers, and demonstrators appointed on the teaching faculty of the school. Recognizing the necessity of embracing every branch of applied science, the principal decided to extend the curriculum of the school so as to embrace five regular departments of instruction, in each of which diplomas would be granted, namely, (1) civil engineering (including mining engineering); (2) mechanical engineering (including electrical engineering); (3) architecture; (4) analytical and applied chemistry; (5) assaying and mining geology.

In 1889-90 the management of the school was entrusted to a council of five, consisting of Professors Galbraith and Ellis, and Messrs. C. H. C. Wright, B.A.Sc., lecturer in architecture; T. R. Rosebrough, M.A., demonstrator in engineering; and L. D. Stewart, O.L.S., D.T.S., lecturer in surveying, with Professor Galbraith as principal. These five are still members of the council, which has been enlarged to include A. P. Coleman, M.A., P.L.D., professor of assaying and metallurgy; J. A. Duff, B.A., lecturer in applied mechanics; G. R. Mickle, B.A., lecturing in mining; R. W. Angus, B.A. Sc., lecturer in mechanical engineering; A. T. Laing, B.A.Sc., demonstrator in surveying; and J. W. Bain, B.A. Sc., demonstrstor in analytical chemistry. In addition six Fellows have been appointed from among the late graduates.

As early as 1888 the necessity of providing increased accommodation was recognized by the Government, and an appropriation made for the erection of a large addition to the building. This addition was completed in 1891, the equipment and the laboratory plant installed being of the best then procurable. The building as now occupied represents a floor space of nearly 60,000 square feet, but, notwithstanding, the accommodation is overtaxed, and the work of the teachers made laborious by the necessity of repeating lectures and laboratory experiments three or four times in order that all the students may receive the instruction. It has also been found necessary, from the same cause, to abandon certain experimental and research work.

That the School of Practical Science is meeting the demands of the people is clearly demonstrated by the almost constant growth in attendance. The present year is the largest yet on record, the attendance being about 220. Of these 105 are taking the mechanical and electrical course, 57 the civil engineering course, and 55 the mining course. In each of these depatrments the faculty and equipment of the school are such as to guarantee the student a thorough training in the scientific principles underlying the practice in the different professions. The splendid equipment in the electrical laboratory has already been described in these columns, while the facilities for the study of mining are equally efficient. The mining course as distinct from that of civil engineering was first established in the session of 1892-93.

It is interesting to learn that the graduates of the School of Practical Science are finding employment in connection with the development of the natural resources of the country, and that many of them are now occupying responsible positions. A glance at the calendar shows that of the 263 living graduates of the school, about 75 per cent. are employed in Canada, while the remaining 25 per cent. are scattered over other parts of the world.

### PROFESSOR GALBRAITH.

The head of this admirable institution, Professor John Galbraith, is a son of the late Thomas Galbraith, of Port Hope, well known to every Scotchman in Canada as the Canadian agent of the "Scottish American." He was born in Montreal on September 5th, 1846, and educated at the Port Hope Grammar School and Toronto University. At the latter he took several scholarships in mathematics and general proficiency, and graduated in 1868 with the degree of B.A., securing the gold medal in mathematics and the Prince of Wales' prize for general proficiency. In 1875 he was granted the degree of M.A. He studied engineering and surveying under Mr. George A. Stewart, chief engineer of the Midland Railway, and was admitted as a Provincial Land Surveyor. He was employed for some ten years in railway construction work on the Intercolonial Railway, the Midland Railway, location of the Georgian Bay branch road, and exploratory surveys for the C.P.R. He was also employed for some time in the Portland Co.'s locomotive shops at Portland, Maine, U. S., and did consulting work in hydraulic engineering, receiving the appointment to the chair of engineering in the School of Science in the fall of 1878.

Professor Galbraith was one of the founders of the Canadian Society of Civil Engineers, serving for five years on the council of that body. He is also an associate member of the institute of Civil Engineers of London, England.

As principal of the School of Science, Professor Galbraith

has labored zealously in its interests, and to him is due much of the credit for the high degree of efficiency which has been attained. At the outset he had an object in view. This was to fit the student for active professional work by giving him a thorough training in scientific principles rather than by attempting to give him a so-called practical training. It is along this line that the efforts of the school have been concentrated, and the wisdom of such a policy seems to be borne out by the results. If one were to enquire from any of his co-workers as to the secret of Professor Galbraith's success, the reply would probably be that it was due to his great qualifications in the direction of organizing the work at the school. As remarked by an intimate acquaintance, "he is a wonderful organizer."

After having completed his 21st year as head of the school, the proposed banquet to be tendered him is a fitting tribute of respect.

## QUESTIONS AND ANSWERS

A subscriber enquires as to what amount of power can be generated by the Westinghouse generators recently installed on the Canadian side of Niagara Falls.

"Mill Owner" writes: Where water power is not obtainable, and where coal can be bought for $1.80 a ton, could electricity be generated and electrically applied by motors to the extent of 500 h.p. as cheaply as by belting and shafts, where said power would be used within a radius of 100 feet of engine shaft.

Ans.—Broadly speaking, the original or capital outlay to cover the cost of the dynamos to convert the mechanical power of the engines into electrical power, the necessary wire to carry that power to the various motors, and the motors to convert it back to its original mechanical shape, will cost considerably more than the belting and shafting necessary for the same work, though in the absence of the detail of the proposed layout, it is impossible to give even approximate figures. The relative cost of operating the two systems will also depend entirely on the details of the particular installation in question, though it is likely to be somewhat in favor of the electric plant, the more so as the average load drops below the full load or rated output of the whole installation. The relative advantage of the two systems, outside of the question of cost, are in every way in favor of the electric, it having the superiority in (1) simplicity and freedom from noise and dirt in the transmitting device (the wires), (2) its great flexibility, (3) facility for future extensions, with but very little change and modifications in the already existing plant, (4) the ability to furnish light as well as power, with a maximum of convenience at a minimum of cost.

"Reader" asks: Why is that a person when receiving an electric shock is unable sometimes to let go of the object grasped.

Ans.—The muscles of the hands are divided into two sets, called extensor and contractile, the former being used to open the hand when the fingers are called on to release their hold, the latter having control over the grasping or clutching powers of the hand and fingers. Obviously, as the latter action requires the exercise of very much more power than the former, the muscles controlling it are proportionately stronger than those of the latter. Now, the action of a current on the muscular system is to excite it to a state of great activity and to deprive it of its ordinary controlling power, the mind; consequently, when the muscles are agitated and left, as it were, to their own devices, the stronger set overcomes the weaker, the result being that the hands remain clenched.

"J. H.," Rossland, B.C., writes: I was told by an agent who was here the other day, that the live wire for a two-phase 3-wire system would cost me less than for a three-phase system; is he right?

Ans.—We presume that the length of line, the voltages and the load are to be the same in each case, which, if so, would make his contention wrong, for the following reason. If you connect a two-phase machine, whose voltage across the terminals of each phase is say 2,000, to three line wires, you will get 2,000 volts between the common or neutral wire and either of the other two, but between these two latter you will get about 2,830 volts. On the other hand, there will be but 2,000 volts across any of the 3 line wires connected to the terminals of a 2,000 volt three-phaser. Such a two-phase system, if run with 2,830 volts across the two outsides, it is quite true, will take about 2 per cent. less copper than the three-phase machine with a minimum voltage of 2,000, but if the voltage of the former be reduced until its maximum line voltage is the same as the other, namely, 2,000 volts, it will require about twice as much copper as the three-phase machine, the length of the line and the load being the same in each case.

"Engineer" says: I want to put in a pump to supply fifty thousand gallons per day to our factory system for use in the various parts of the shop, and propose to pipe the discharge from the pump into a tank 96 feet from the ground, about how much horse-power will it take to drive the pump?

Ans.—We suppose that you intend to deliver the above 50,000 gallons in an ordinary working day of 10 hours, and also that you refer to the standard Imperial or English gallon, not the U. S., the former weighing 10 lbs. per gallon, the latter about 8 1/3. If we are correct in our supposition, the following is the easiest way to get the horse-power necessary: Since a h.p. is equivalent to 33,000 lbs. raised one foot in one minute, which is usually expressed as 33,000 foot pound minutes, the problem consists in finding how many foot pound minutes there are consumed in doing the work described, which is given by the following: 50,000 gallons per 10 hours = 5,000 gallons per hour = 83 1/3 gallons per minute; 83 1/3 gallons at 10 lbs. per gallon weigh 833 1/3 lbs., which raised through 96 feet will represent 80,000 foot pound minutes; this divided by 33,000, which as explained above are the number of foot pound minutes in a horse power, will give the h.p. required, which is slightly over 2 4/10; but it must be remembered that this is the delivered output of the pump, which, including mechanical and water frictions, is of above 60 efficiency, so to get the actual horse-power consumption required, 40% should be added to the above figure, giving a final result of 3 39/100 h.p.

Mr. Donald McIntyre, who owns a water power about three miles north of Paisley, Ont., has found it necessary to increase his electric lighting plant. He has ordered from the Royal Electric Company one of their 60 h. p. S.K.C. two-phase alternating current generators, and has added a third wire to his lines from the water power to the town, thus putting him in a position to furnish power as well as light.

## THE ELECTRIC STORAGE BATTERY AND ITS COMMERCIAL APPLICATION*.

By C. E. Brown.

The advent of the storage battery accumulator, or secondary battery, as it is variously called, into the field of electrical engineering is of comparative recent date. This is more especially true on this side of the Atlantic than in European countries, where its use had preceded by several years its general application on this side.

But a few years ago, perhaps five or six, it was necessary to point to European practice for all examples of successful accumulator application on a large scale and along advanced lines. This is no longer the case, as American storage battery practice is as far advanced as in any part of the world, and the American storage battery has no superior. The largest installations, too, are to be found in American cities. Its growth in importance in these few years is little short of phenomenal, and it is still rapidly increasing. The majority of the very large central stations, such as those of the Edison illuminating companies of the larger cities and the large street railway companies, depend very largely upon it, and its adoption is coming to be quite general in medium and smaller sized stations.

The history of the storage battery is practically included in the last 30 years, though the phenomena on which it is based was observed as far back as 1801. In that year Gautherot found that after decomposing water with a volta's cell, if the platinum or silver electrodes were connected together, a secondary current would flow for a brief time. The history of the storage battery from this time until the time of Plante includes the names of Volta, Davy, Schoenbein, Grove, Wheatstone, Siemens, Faraday, and others, but no practical results seem to have followed. In 1860 Gaston Plante constructed the first practical storage cell from two sheets of lead 60 cms. long by 20 cms. broad by 1 mm thick (25″x 8″x1/25″) coiled into cylindrical form, the two plates being separated by felt and the whole immersed in dilute sulphuric acid. Plante continued his researches up to 1879, which practically determined the state of the art. In 1879 Metzger applied the active material mechanically, and in 1881 Faure obtained important patents on mechanical application and shortening of the forming process. The history from this time has been in connection with its applications to practical use.

"The storage battery," according to Houston, "consists of two inert plates of metal or metallic compounds immersed in an electrolyte which is incapable of acting upon them considerably until a current has been passed from one plate to the other. On the passage of a current through the electrolyte its decomposition is effected and the electro positive or electro negative radicals are deposited on the plates, so that on the cessation of the charging current there remains a voltaic cell capable of generating an electric current."

The commercial storage battery of to-day consists of plates or frames of lead or an alloy of lead, with oxides of lead formed on, or pasted on the surface or in grooves or pockets of the plate, three or more plates being assembled together and immersed in an electrolyte of dilute sulphuric acid. The alternate plates are connected together for one electrode and the intermediate ones for the other. The metallic plate or frame of lead or an alloy of lead form the framework or support of the electrode and serves as a means of conducting the current to and from the active material. The oxides or other compounds on the surface or in the pockets or grooves are the active material, and together with the electrolyte are the seat of chemical actions which result in the formation of compounds which in the charged state are of relatively high energy of formation and in the discharged state relatively low, so that in passing from the former to the latter energy is given out, and passing from the latter to the former energy is absorbed. This amount of energy given out or absorbed is practically equal to to the electrical energy of discharge or charge. The sulphuric acid is the active part of the electrolyte, the water acting principally as a solvent used to give more favorable conditions for the action of the sulphuric acid. The plates are usually separated by perforated sheets of hard rubber or celluloid or glass rods, and all plates bound together with rubber bands. The containing vessel may be of glass or hard rubber or of lead lined wooden boxes. The number of plates varies from three to nearly one hundred in the largest batteries installed, with a corresponding variation in capacity from a fraction of one ampere to 10,000 or 12,000 amperes, the current depending both on the number and size of the plates. The voltage, on the contrary, depends on the number of cells, being approximately two volts per cell for commercial batteries.

The form and construction of plates differ very greatly. The first Plante cells were made up of thin sheets of lead with an insulating material between them. Plante found that these plates to give much capacity must be made porous on their surface. To accomplish this result he changed his cells, first putting in the current in one direction, then discharged them, reversed connections, and again charged with the current in the opposite direction. Thus the plate that was made positive on one charge was made negative on the next succeeding charge, and this process was repeated a large number of times. This he called forming the battery, and it required no less than thirty reversals to bring it up to its full capacity. After his plates were well formed he found that they soon became rotten, owing no doubt to the thinness of the plate, the chemical actions having penetrated completely through. The capacity of these cells per pound of plate was large, and has not been exceeded by the same class of battery to-day.

In 1879 Metzger did away with the tedious and expensive forming process by making boxes of perforated lead, which he filled with a mixture of lead oxide, sulphuric acid and potassium silicate for his active material. One box so formed he used for his positive plate and another for his negative. This cell was formed in two or three days, a great improvement over the very long period by the old Plante process.

Faure, working independently and at about the same time, developed this class of plate in which the substance to become the active material is mechanically applied, and which has since come to be known by his name. He applied lead oxide in the form of a paste to the surface of lead plates such as had been previously used by Plante. The positive and negative plates were separated by felt and dilute sulphuric acid used as an electrolyte.

These two types of plate, the Plante and the Faure, are the prototype of all commercial storage battery plates in use to-day, and practice is about evenly divided between them. In general, European practice inclines toward the use of the Faure type, while American practice favors the Plante. The Faure type gives a comparatively large output per pound of plate, but is best suited for moderate rates of discharge covering a considerable period of time, whereas the Plante gives a smaller output per pound, but is capable of working at very high rates of discharge.

The thin, flat plates used in the early Plante cells have been subjected to numerous modifications devised for getting a greater surface with heavier and more rigid plates, for securing better adhesion of the active material when found, and obtaining greater durability, etc. A few descriptions of typical plates will serve to illustrate the direction of these improvements. No pretense of completeness is made in these lists; that would take a far longer paper than this is designed to be, neither is it claimed that the plates described are necessarily the best of their type. It is thought, however, that they are typical of good storage battery practice to-day.

The Epstein plate is cast with deep grooves on each side, thus combining with a rigid and durable plate a large amount of surface on which the active material is formed.

The Williard plate is made from pure rolled lead and has grooves cut in each side at an angle with the horizontal, forming troughs for holding the active material. It is claimed that the plate can be bent up into almost any shape without dislodging the active material. The thin layer of active material and the large amount of surface allows of rapid discharge with danger of buckling. Each positive plate is enclosed in a perforated hard rubber envelope to avoid contact between plates.

The Ohio storage battery is made of pure rolled lead sheets. Circular grooves 1 inch in diameter and 3/16 inches deep and 1/16 in. thick are raised by rolling in a machine. The different circular grooves are separated by 1/4 inch to avoid any tendency towards buckling.

The Rooney plate is made up of alternate corrugated and straight strips of thin rolled sheet lead placed on edge and burned into a conducting strip or rib of the lead frame at each end. This forms a very open plate with a large amount of surface.

Porous plates have been made by casting lead with powdered coke, or with pumice stone, by the formation of sulphide, the sulphur afterwards being taken out, and notably by the use of chloride of lead and zinc. The object in making these porous or partially porous plates, is to obtain a large amount of surface of the lead plate on which the active material may be found in minute quantities. The great amount of surface with the corresponding large amount of active material insures large capacity, while the minute subdivision of the active material permits of rapid discharge.

In the chloride battery the substance which is to become the basis of the active material is chloride of lead mixed with a certain proportion of chloride of zinc, and cast in small pastelles. These pastelles are then placed in a mould and a frame of an alloy of lead and antimony cast around them under great pressure. The antimony gives strength and hardness to the grid, and it is claimed is not acted on by the acid, thus avoiding local action. The grids are then packed between zinc plates in a tank containing a dilute solution of zinc chloride, and short circuited. This removes most of the chloride from the plate, the last traces being removed by thorough washing, leaving a pure spongy lead. This process was formerly used for both plates, but is now used only on the negative. The positive plate is obtained by casting the lead antimony grid under pressure, 5/16 in. thick, and with holes 3/4 in. in diameter. A corrugated ribbon of soft pure lead is rolled up into a spiral and pushed into these holes. The active material is formed electro-chemically from this ribbon, and causes it to expand and fill the hole tightly, making good electrical contact with the plate.

The method of formation of all these plates is quite different than that followed with the early Plante cells. The method is different with almost every manufacturer, but the object aimed at is similar in each case, namely, to form the cell quickly and avoid the tedious and expensive method of numerous charges, discharges and reversals, and at the same time procure a hard and durable plate. The plates are usually pickled in a bath of dilute nitric or acetic acid, or in some alkaline solution capable of acting on the lead until the action has penetrated to a sufficient depth, after which the coating produced is reduced to a spongy lead, or changed to lead oxide. The plate is then formed in the usual manner by charging. The cell never attains to its full capacity on the first charge, but will increase with successive chargings for quite a period of time.

The Faure, or pasted type of plate, has likewise been subjected to numerous modifications. Metzger used a perforated lead box filled with the active material; Faure spread his active material on the surface of a lead plate. The difficulties of the first

*Paper read before the Peterborough Engineering Club by C. E. Brown, of the Canadian General Electric Company.

were principally the great expansion due to so large a body of active material, the necessarily slow rate of discharge since the tendency of the action is from the surface inward, the poor electrical contact, etc. The difficulties of the second were principally due to the insufficient adhesion of the active material and the consequent poor electrical contact, danger of short circuits from falling of active material, and the rapid deterioration. These difficulties have been largely overcome by sub-dividing the active material and placing it in small pockets or grooves in the surface of the plate, or in holes extending through the plate. The pockets or holes are usually made smaller at the surface than in the interior, so as to wedge the active material in place, or in the case of grooves, they are made narrow, so that the plate will have a good grip upon the active material.

One of the most fruitful sources of trouble with storage batteries has been the tendency of the plate to buckle or bend out of shape with operation. This has been very largely overcome in the better modern batteries, and is no longer a source of serious trouble. The active material of the positive plate expands during discharge, and as the action on the material is never uniform, some portions will expand more than others, and tend to throw the plate out of shape, and the more rapid the discharge the greater will be the tendency. The remedy is largely in subdivision of the active material and allowing opportunity to expand in one direction. A brief description of a battery which has achieved considerable success on the continent of Europe, the Tudor battery, will serve to illustrate this class of plate.

The plates are made from pure rolled lead about 3/8 in. thick, and are grooved on both sides, the grooves being about 1/8 in. wide and a little greater in depth. These plates are first slightly peroxidized by electrolysis, forming $PbO_2$, and then the grooves are packed with oxides of lead, after which the plate is rolled to keep the active material in place. As the active material crumbles away, due to continued use, the action penetrates deeper into the metallic lead of the plate and keeps up the supply of active material, so that the full capacity of the plate will be maintained, even though the active material at first pasted into the grooves should entirely fall away.

The numerous small sections of the active material insures a large surface and permits of a high rate of discharge. The smallness of the section of active material prevents excessive swelling and consequent buckling of the plate. The method of formation gives unusually good electrical contact between the active material and the frame. Perforated sheets of hard rubber are inserted between the plates in this as in most batteries.

Numerous attempts have been made to reduce the weight of the battery by increasing the proportionate weight of active material. Among these are the use of porous earthenware containing plates to support the active material and press it against a thin sheet of lead, which serves to carry away the current, an earthenware plate being placed on each side of the lead sheet to form one plate and all plates firmly bound together with rubber bands. Wool felt has been used in strips to form pockets on each side of a sheet of lead, and the pockets filled with the active material, which is kept in place by a light sheet of perforated or porous insulating material, the various plates being bound tightly together. Perforated cells, or envelopes of celluloid filled with active material, are used for electrodes, the current being taken out by lead wires or strips passing down the center of the cell or envelope. So far as I know, none of these batteries have proved a real commercial success, except for traction purposes, where lightness is so important a consideration that some other considerations will be sacrificed to obtain it. One serious difficulty with this class of cell is the rather poor electrical contact between the active material and the lead plate, which lends itself to the formation of the insoluable lead sulphate on the surface of the lead, limiting further action by its insulating properties. The electrolyte for the lead storage battery is always dilute sulphuric acid. The proportion of acid to water is usually determined by the specific gravity of the combination and is used from 1.2 to 1.3.

In pasted or Faure type of plates red lead minium ($Pb_3O_4$) is generally used on the positive plate, and litharge ($PbO$) on the negative plate. Combinations of these oxides or other compounds are sometimes used. In some later batteries a mixture of lead sulphate and lead oxide is used. Lead is not the only metal that has been used in storage batteries, copper and zinc both having been used, but, as these batteries have never achieved any marked success commercially, they will not be discussed here.

The chemical theory of the storage battery is still, to a large extent, in the speculative stage. To the outsider it would seem an easy task to analyze the various elements entering into the action before and after charge and discharge, and determine the actual reactions that take place. When, however, the chemist approaches the task it is found to be one of extreme difficulty, so difficult that after 15 or 20 years of research and persistent effort to solve the problem, it is still, to a large extent, shrouded in mystery as to the real nature of the reactions that take place. The difficulties were expressed by Dr. Frankland in the following words: "The physical qualities of the cells are capable of very accurate estimate and investigation, but, when you come to attempt to ascertain the chemical charges that occur in charging and discharging of a storage cell, you encounter formidable difficulties. The outsider has no idea of these difficulties. Nothing seems more simple than to determine the chemical changes that take place in either the positive or the negative plate of a storage battery. It is not so in reality. The substances used as active materials are in the first place mixtures, and the materials obtained at the end of the reactions are also mixtures, and these mixtures are insoluable in any reagent which does not decompose them. They cannot be volatilized; they cannot be subjected to any process of solution and crystalization in order to separate and purify their elements." This will give you something of an idea of the difficulties in the way of an exact determination of the nature of the actions taking place.

The earlier ideas of the action of the storage battery were somewhat vague, and it was spoken of by no less an authority than Maxwell as storing up a quantity of energy in a manner somewhat analagous to the ordinary condenser. The first definite chemical theory was what is known as the occluded gas theory, namely, that the active material of the electrolyte is the water, and that this is decomposed in charging into its two components, oxygen and hydrogen gas, the oxygen being liberated at the positive and the hydrogen at the negative electrode where they are occluded by the electrode. The discharge would be the reverse action, the two gases reuniting in the formation of water. In this theory the sulphuric acid serves only the purpose of increasing the conductivity of the electrolyte. This theory is disproved by the fact that it only requires about 1.5 volts to electrolyze water between platinum electrodes, and therefore only 1.5 volts could be obtained by the reunion of its constitutents in discharge, whereas the actual voltage of the storage battery is about two volts during the greater part of the discharge. It would be necessary to presuppose some other action than mere occlusion at the electrodes to account for this extra voltage. It was also observed that action did take place on the electrodes, the negative being reduced to metallic lead and the positive peroxidized during charge. These effects were attributed to local or waste actions. This theory is, I believe, still accepted by some authorities. It is, however, now generally discredited.

About 1882 the double sulphating theory was advanced, and this theory, with modifications and additions, despite considerable opposition, is the one generally accepted to-day. According to this theory, sulphate of lead ($P_bSO_4$) is formed on both electrodes during discharge, accompanied by the withdrawal of sulphuric acid ($H_2SO_4$) from the electrolyte and its replacement by water, $H_2O$. In charging the sulphate on the negative electrode is reduced to spongy metallic lead, and on the positive to peroxide of lead ($P_bO_2$) with the formation of sulphuric acid and the withdrawal of water from the electrolyte. These reactions, beginning with the charged condition, may be represented by the following equations :

For the positive plate : $P_b O_2 + H_2SO_4 = P_bSO_4 + H_2O + O$.

For the negative plate : $P_b + O + H_2 SO_4 = P_b SO_4 + H_2O$.

Combining these negatives we have : $P_b O_2 + 2H_2 SO_4 + P_b = P_b SO_4 + 2H_2O + P_b SO_4$ for the entire cell.

It is quite certain, however, that the action is not as simple as represented in these equations, but they seem to represent the net result of the normal action of the battery. It should be remembered that these equations do not represent the entire material of the cell, but only those parts actually entering into chemical reactions. This includes only a small percentage of the electrolyte and by no means all of the active materials. The action is, fortunately, and it might also be said unfortunately, a self limiting process ; unfortunately, because it limits the output of the cell to only a portion of the active material ; and fortunately, because if the active material were once entirely converted to lead sulphate it would become non-conducting and non-electrolizable, and it would be impossible to reverse the cell and again charge it. When the peroxide is reduced to about 31 per cent. of the original amount on the positive plate, action will cease entirely. The voltage begins to drop so as to make further discharge undesirable considerably earlier.

The charging process is substantially the reverse of this, but there seems to be some slight difference or extra action, as, after making all allowance for resistance drop, the charging voltage is somewhat higher than that of discharge ; and the sudden rise of voltage as the cell becomes charged and sudden fall at the end of discharge would seem to indicate some further irregular actions.

The attempt has been made to explain all these variations of voltage as due to variation in the density of the sulphuric acid within the substance of the active material. It is well known that the voltage of the cell increases in some degree with the increase in density of the electrolyte. Then, as sulphuric acid is formed during charge and withdrawn during discharge, it is evident that the density of the electrolyte is greater or less within the active material of the electrode direct, as the lack of porosity prevents complete diffusion of the electrolyte. The sudden rise in voltage at the end of charge and the sudden fall at the end of discharge might be explained by the decrease in porosity of the active material at these stages, causing greatly increased density of the electrolyte in one case and greatly decreased density in the other. Whether this explanation is sufficient to account for all variations in the voltage is not entirely clear.

Another, and perhaps more plausable theory to account for the rise in voltage at the end of charge, is the formation of persulphuric acid $H_2(SO_4)_2$. This is supposed to be brought about by the sulphion ($SO_4$) combining with the sulphuric acid in the absence of more available lead to unite with. This combination is very unstable and almost immediately breaks up, with the following result :

$H_2(SO_4)_2 + 2H_2O = 2H_2 SO_4 + H_2O_2$.

$H_2O_2 = H_2O + O$.

This not only accounts for the rise in voltage, but also for the abundance of oxygen passing off when the cell becomes fully charged. The double sulphation theory is supported by the following facts : The thermo chemical equivalents of the combinations claimed would just account for the voltage observed on discharge ; the increase in density of electrolyte during charge and decrease during discharge, which are well known phenomena, and the formation of lead sulphate during healthy operation,

which seems to be unquestioned. These are the more important points in support of this theory, which seems to have no formidable rival at the present time.

The efficiency of the storage battery as obtained by laboratory tests under favorable circumstances is about 80 to 85 per cent. It is doubted if it often exceeds 70 to 75 per cent. under actual commercial conditions. This difference is due to leakage, to local action, to the cells not being kept in the best conditions, and to several other causes not occurring in laboratory tests. The losses occurring in normal action are divided by Crosby and Bell as follows: 1st, the direct losses due to heating; 2nd, the losses due to local action between the supporting grid and the active material; 3rd, the losses due to local action in the active material itself; 4th, the losses due to unreversed chemical action. The first is the $C^2R$ loss and has been reduced to quite a moderate figure in modern cells. The second is not a very serious loss in well designed cells except in cases where cells are required to stand for quite a period of time partly discharged. The third and fourth are usually the most formidable losses. The third can be reduced to some extent by subdivision of the active material, but apparently can not be eliminated. It is due largely to unequal action in the active material, and the most rigid uniformity in manufacture will not prevent this. The fourth is partly due to the formation of irreversible chemical compounds and partly to those electrolytic actions which produce free hydrogen, oxygen, ozone, etc. There seems to be no method of effectually limiting these losses. Omitting the $C^2R$ loss, these wasteful losses have been found in some tests to be as high as 17 per cent. of the entire energy put into the cell in charging.

The theoretical value of lead peroxide has been calculated at 4.48 grammes per ampere hour, or approximately 100 ampere hours per pound. Assuming the weight of spongy lead on the negative plate to be equal to the weight of peroxide on the positive, this would give 50 ampere hours per pound of active material. Plates of the highest capacity yet manufactured do not, however, give more than 16 ampere hours per pound of active material, and as the active material forms but from 20 to 50 per cent. of the weight of the plate, the ampere hours per pound of plate will be about three to seven or eight in the best commercial cells. These figures are comparable to the efficiency of the steam engine calculated from the heating value of the coal. They suggest the great possibility of improvement, but as in the case of the steam engine, there are natural laws which prevent the complete utilization of this energy.

The Electric Storage Battery Company names the following useful applications of the storage battery: Central station lighting; central station power; trolley regulations; isolated lighting; street can traction; electric locomotives; electric launches; electric carriages; electric elevators; train lighting; telegraph and telephone, and many others which I will not mention here. Some of these applications will be discussed somewhat in detail, but before taking up these applications it may be well to state some of the general considerations which make the application of the storage battery desirable or undesirable. The storage battery is not a prime mover. It must receive its energy from some other source, store it up, and give it out again as required. It is, therefore, as regards economy, suitable for those uses only in which it can receive its energy at some time or place where energy can be had more cheaply than at the time or place that it is required to be used. For example, in the central station power can be produced generally far cheaper at the hours of minimum load than at maximum, and this is just as true for the momentary fluctuation as for the all day load curve. For these reasons the storage battery is not well adapted to service where steady continuous loads are required, except in cases where the energy is small or as reserve of great reliability. This class of service is better served directly from the prime mover. The use of a steam engine during four hours of the day to charge a storage battery which is to firnish light and power for the remaining 20 hours is not often an economical operation, however convenient it may be. On the other hand, the storage battery is well suited to loads having sudden fluctuations or of short durations. A single case will illustrate this. The battery installed by the Chicago Edison Company is rated at 22,400 ampere hours for an eight hour discharge, or at the rate of 2,800 amperes. It is quite safe to say that generating machinery rated at 2,800 amperes, including boilers, engines, feed pumps, dynamos, etc., could be installed for less money than this battery cost. But whereas the generating machinery might safely carry 4000 amperes for one hour, probably not more, the battery is guaranteed to deliver 11,000 amperes for one hour, a ratio of 2¾ to 1 in favor of the battery, and far more than enough to overcome the difference in first cost; and the battery actually does deliver considerable more than its guaranteed rate, reaching 14,000 to 15,000 amperes for short periods.

The uses to which a battery can be applied with advantage have been stated as follows: 1st, to carry the peak of the load at maximum hours; 2nd, to carry the entire load at minimum hours; 3rd, to act as equalizer or reservoir; 4th, for the equipment of annex stations. The first of these uses is the one which is generally of the most importance in illuminating stations, though the fourth is of considerable importance in many cases. The first, third and fourth are of about equal importance in railway work. The second is not much used on this side of the Atlantic in connection with steam plants.

Coming back to particular applications, we will endeavor to point out some of the ways in which the storage battery has made, or is making, itself useful. One of the applications in which it has met with undoubted success, but of which we hear little, is in connection with telegraphy. With great conservatism the telegraph campanies clung to the primary battery long after it had been superceded by the generator in almost every other commercial application. The generator is not, however, well adapted to this class of work directly, except in very large equipments where the amount of energy consumed is quite large and the extra cost of complete reserve equipment is not prohibitive. It becomes, then, a question largely between the relative merits of the primary and the secondary battery, and a fair trial is all that is required to establish the great superiority of the latter in practically all cases where charging current is available. Its advantages over the primary battery may be stated briefly as follows: Its first cost is 75 or 80 per cent. of that of the same capacity of primary batteries; its maintenance, including cost of current for charging, 10 per cent. It should be added that this is the important item, as the maintenance cost of primary batteries per year is from two to three times the first cost, floor space from 15 to 25 per cent., and far more satisfactory operation. It would seem that the storage battery has before it a great field for expansion in connection with the telegraph; and what has been said with regard to the telegraph is in a large measure equally true for the telephone, for fire alarm systems, and other similar classes of work.

The electric lighting of railway trains from the storage battery, or with storage battery auxiliary, offers the most satisfactory solution of the difficult problem of train lighting yet presented, but has not always proven the most economical. The method of application follows two lines. Where the run is short or of moderate length, say from 5 to 12 to 15 hours, a battery of sufficient size to carry the load of the train for one trip is installed on one car, or more often it is sub-divided and a battery placed on each car. This battery is then charged in the train yards at each end of the run, or removed and a fresh battery put in place. For long runs of many hours, or perhaps days, this method cannot be used except by establishing stations along the line for recharging batteries which are exchanged at these points. For this class of service a generator may be installed on the train and the lighting current obtained directly from it, the storage battery acting as a reserve to take the load when the locomotive is uncoupled, or at all stops and times of slow speed, if the generator is run from the car axle. For the man who reads his newspaper on the train, the better distribution of light by numerous electric lights will fill a long felt want, and the user of the sleeping car, after a brief experience with it, will wonder how he ever got along without the berth light. One of the best illustrations of train lighting is in the case of the Chicago, Burlington & Quincy Railway, between Chicago and Minneapolis. These trains have been lighted by storage batteries for about three years, and they have given perfect satisfaction. The trains referred to are said to be the finest in the world. Each car is equipped with a battery, the batteries all running in parallel. They are charged while the train stands at the station at each end of each run, and no time is lost by the operation. The trains make one trip daily, which occupies 14 hours. The cars are equipped with from 25 to 75 lights, each according to the nature of the car, and each berth in the sleeper has its frosted globe lamp. The expense of lighting this train has been a little greater than it would have been with oil or gas, but the travelling public once having become accustomed to this quality of lighting will not readily put up with anything inferior.

In the larger field of storage battery auxiliaries to central stations, both light, power and railway, we will find that the determining question in the installation of such batteries is, does it pay—will the investment in storage battery yield a larger dividend, or will it cost the station as a whole to yield larger dividends than the same investment in generating machinery? and this question must be answered for each individual station. The use of a battery as a reserve in case of a necessary shut down, or as a means of steadying the buss bar voltage, is important, but batteries are seldom installed principally for this purpose, they are installed to earn dividends. From the largely increased number of plants installed in the last few years, since the system has been fairly tested, it would seem that they have succeeded in earning dividends in a large number of cases. After the installation of the first battery by the Boston Edison Company, Mr. C. S. Edgar, of that company, stated the case which confronted them and the results obtained somewhat as follows: The peak of their load represented 50 per cent. of the total load at the time of maximum, but only 10 per cent. of the total output for the 24 hours. It became necessary to provide some means of carrying this peak of the load owing to increasing output. If a steam plant were installed to carry this 10 per cent. of the output, it would require a plant of equal capacity with existing steam plant, the existing plant carrying the other 90 per cent. without difficulty. It was found that a steam plant of the required capacity would cost $65,000, a battery plant complete could be installed for $50,000. The battery was installed with a guarantee to be kept in good working order for 6 per cent. per annum on cost of cells. The battery improved the load factor greatly, and it became possible to run the generating machinery at a load never less than 75 per cent. of the rated full load. This, of course, reduced the operating expenses and brought up the efficiency of the steam plant. It has been found by careful records that the losses in the battery are offset more than four fold by the reduced losses in the generating machinery, because of the higher efficiency of operation with the higher load factor. The results, then, in this particular case, show lower first cost, lower operating expenses, and a depreciation at least as low as could have been obtained with an equivalent steam plant. This appears to be fairly typical of the results to be obtained in most illuminating stations of large or moderately large capacity. The load curve in these stations has a peak of short duration which is quite a large percentage of the load, and which is very expen-

sively and inefficiently carried by steam generating machinery.

It is interesting to note that the Boston Edison Company now has four batteries installed, and that their generating machinery, which is of the best multipolar type, has a rated capacity of less than 50 per cent. of the load on the station at the peak of the load curve, and carries 90 per cent. of the total output of the station directly. In railway power stations it is not alone the peaks that need looking after, but also the sudden variations or fluctuations which so often limit the output of the generator to an average far below the rated capacity. The purpose of the battery in street railway power stations is to carry the peak of the load when it comes, to charge when the load is light, and to take the fluctuations at all times, charging at one moment and discharging at the next, so that the load on the generating machinery remains nearly constant. This use is quite similar to that already described for illuminating stations, except that it is necessary to keep the battery floating on the line during the whole time it is used for equalizing the fluctuations. Another class of work quite different from this is the use of battery sub-stations on lines extending a long distance from the power station and on which the drop becomes excessive at times of heavy load. There are several methods of taking care of such cases—putting in sufficient copper in the feeder to keep the voltage up, installing separate steam plant at the location needed, the use of a booster and separate feeders for that line, or a storage battery sub-station. The first of these remedies is usually the most expensive. The second gives the highest operating expense, and the third, though often the cheapest, is necessarily of very low efficiency, often under 50 per cent. Without entering into the evidence on either side, it is sufficient to say that in many cases the battery offers the most satisfactory solution of the problem. For this class of work the battery is generally connected directly across the line without booster or other apparatus. It is calculated for a voltage equal to the voltage on the line with the average load. When the load is less the drop will be less and the battery will charge. When the load is greater the drop will be greater and the battery will discharge, thus taking nearly constant current over the feeders at all times, the conditions of maximum economy.

A rather novel case of this use of the storage battery is found in connection with the Brooklyn Heights Railway Company. On their Coney Island line the traffic is very heavy for three or four months in the summer and is practically nil at other seasons. For this service they have installed on six freight cars a large battery which is run out and connected up near the end of the line in summer time. When the season is over the battery is run back to the station or to any point on the line where it will be the most serviceable.

It is often thought that a battery is only applicable to large stations, but a little enquiry will show that very beneficial results can often be obtained in small stations. In Peekskill, N. Y., the Street Railway Company operates 4¾ miles of track, running from three to five cars. With the five car schedule the fluctuations are from zero to 310 amperes at 575 volts, or 178 k.w., yet this load is carried on a 60 k. w. generator, with the assistance of a battery rated at 160 amperes for one hour, and a small differential booster operating automatically, and the load on the generator is practically constant at about full load. The curve of generator and battery load will explain more than any words. The saving in generator capacity and the increased efficiency of operation will be apparent at a glance.

Before leaving the subject of central station batteries, it may be well to sketch briefly the methods of operation in these plants. In illuminating stations the use of end cell switches is almost universal. The battery terminals for a number of the end cells (this number being as high as 30 for the Chicago Edison Company) are carried to the switch-board and connected to a set of contact bars. A moving switch or contact piece, connected to one line or busbar, travels over these terminals, thus cutting in or out cells as required to give the required voltage. This arrangement is usually operated electrically and is semi-automatic.

A switch must be closed by hand, which starts the moving contact to cut in or cut out cells as desired. This contact once started cuts out one cell and then stops, and cannot be stopped sooner. If this effect is not enough the switch may be closed again and so on until as many cells are cut out as desired. The object of this arrangement is to prevent the switch stopping on two contacts and thus short-circuiting a cell.

For street railway work it is necessary to have some automatic means of regulating the voltage on a battery, as the fluctuations are so sudden that no hand operated method could possibly answer the purpose. Railway generators are invariably compounded, and if the battery were connected directly across the busbars, their load would increase directly as the load on the system increased and only aggravate the trouble they are intended to overcome.

The general arrangement for this class of work is to use a differential booster. This is a generator wound with a weak shunt field and a very strong series field. The series field is connected in opposition to the short field and in series with the line. The armature is connected in series with the battery and in such direction that the voltage generated by the shunt field opposes the battery voltage and the voltage generated by the series field assists it. The adjustment is so made that when the load on the line is normal the booster voltage will be zero and the battery neither receives nor gives current. When the load on the line falls, the voltage of the booster in opposition to the battery rises on account of the shunt field overcoming the series, and forces current through the battery, charging it and keeping up the load on the generators. When the load on the line rises the voltage of the booster rises, assisting the battery voltage, due to the series field overcoming the shunt and the battery discharger relieving the generator of a part of the line load. If it is found at any time that the battery is discharging faster than it is charging, a slight turn of the shunt field rheostat will bring up the shunt field and give the battery more charge and bring a slightly larger load on the generators, or vice versa. This arrangement when once adjusted works with great satisfaction and regulates the load on the generator with great constancy.

There is one other application in connection with central stations which I wish to mention. I refer to the use of the storage battery as a substitute for the usual isolated station, in office buildings, large stores, etc. The load in these buildings is usually quite large for a short time and relatively small during the remainder of the day. The time of maximum load coincides with the peak of the central station load, so that they are unprofitable customers when served in the usual way, hence the isolated stations are so generally installed. By the use of storage batteries these buildings may be cut off from the station entirely during the hours of its maximum load, the storage battery carrying the entire load of the building. During the remainder of the day the battery may float on the lines, acting as a regulator for the elevators and charging when the station load is a minimum. In one particular case the illuminating company was ready to furnish power for this method at 4½ cents per k.w. hour, when their price for the usual method was 13 cents. The cost of battery will not differ much from the cost of a steam plant with direct connected units, and it is quite certain that the operating expenses would be less in most cases. There would seem to be an extensive field in the larger cities.

I had hoped to take up the subject of storage battery traction at some length, but owing to the lack of time and the length this paper has already assumed, I will dismiss it with a few words. Technically speaking, the storage battery street car has proved an entire success. The various difficulties that have loomed up from time to time have been satisfactorily settled, and lines have operated for months giving as good service as could be asked. But the proof of the pudding is in the eating, and as these roads have generally been abandoned after a period of successful operation, there is but one conclusion, namely, they have not been a commercial success.

The automobile is not so easily disposed of. It seems to be a settled thing that there are to be automobiles, and quite a good many of them in the near future in the larger cities. Shall they be electrics or some other kind, gasoline or steam? The points in favor of the electrics are briefly about as follows: Extreme simplicity in construction and operation; entire freedom from danger of explosion or fire and from smoke, disagreeable odors, excessive oil and dirt, etc.; low operating expenses as compared with horse traction in the larger cities. The points against them in the comparison are: Great weight of battery and consequent limit of grades that can be ascended; large first cost; limit of operation to a certain radius from the charging station to which it must return for a new charge when its supply is exhausted.

These objections, though prohibitive of the general adoption of the electric automobile at the present time, are not so serious against city service as would at first appear. The electric can mount a grade of 12 per cent., and this is as steep as will often be encountered on city streets. The first cost is not greater than that of horse carriages used for city driving purposes, with a suitable driving team. With the multiplication of automobiles, charging stations will be established all over the larger cities and well out into the surrounding country, so that no difficulty will be experienced in obtaining a charge once they are in general use. In spite of the difficulties in the way, I have considerable faith in the ultimate triumph of the electric automobile in a somewhat limited field.

## TRADE NOTES.

The Robb Engineering Co. are building a 250 horse power engine for shipment to Calcutta, India. The order was received through their representatives in London, Messrs. Dick, Kerr & Co.

The Central Electric Company, of Portage la Prairie, Man., have just installed and placed in operation a 150 k. w. S. K. C. two phase alternator. They contemplate going into the power business.

The War Eagle Mining Co., of Rossland, B. C., have placed their order with the Royal Electric Company for one of their two-phase 20 h. p. S. K. C. induction motors. This is one of a series of motors that will be installed by these people for small power purposes in and about their mines.

The Hutton Eectric Company, of Brampton and Huttonville, who had their plant destroyed by fire last spring, and who have been operating temporarily since, have purchased from the Royal Electric Company one 1500 light alternating current generator and one 50 light arc machine. These are in use at the hydraulic power house at Huttonville.

The Atlantic Grindstone Company, of Providence, R. I., who purchased the gripstone quarry at Lower Cove, N. S., some months ago, intend equipping the quarry with modern machinery and largely increasing the output. The power will be supplied by two 125 horse power Mumford boilers and a 250 horse power Robb-Armstrong engine, which are being built by the Robb Engineering Company.

The Perth Water & Electric Co., who have been operating their water system by electrically driven pumps from their lighting station, where they have had a 150 k. w. S. K. C. generator in operation for the past two years, have found it necessary to increase their plant both for power and light, and have placed their order with the Royal Electric Company for one of their 200 k. w. S. K. C. two phase generators, which is being installed to work in parallel with their present outfit.

The Canadian Oak Belting Co., of Montreal, have removed their belt factory to Brockville, Ont., having purchased the tannery there formerly owned by McLaren & McCrady. This tannery is equipped with modern appliances for turning out a superior quality of oak tanned leather, especially suitable for the manufacture of leather belting. The tannery and belt factory will be under the management of Mr. J. B. McArthur, who has had twenty-eight years' experience in the business. They will continue their office at 771 Craig street, Montreal.

Messrs. Fair & Sargent, of Bancroft, Ont., are about to put in an electric light plant in that town. They have placed their order with the Royal Electric Company for two direct current generators, with a capacity of about 500 lights, also the necessary supplies. Messrs. Fair & Sargent certainly are enterprising and deserve success in their venture. They expect to have the lights in operation by Christmas.

## NEW ALTERNATING ARC LAMP.

The accompanying illustration is of a new alterating arc lamp, the inventors of which are Messrs. F. W. Martin, station superintendent, and Frank Stewart, of the Hamilton Electric Light & Cataract Power Co., of Hamilton, Ont.

The lamp as shown has an octagon bonnet, nicely oxidized. The lamp is less than 30 inches long, and looks very neat and attractive. It is for ordinary use, such as for store lighting. Altogether, this lamp is designed in eight different styles, some for office or warehouse use, some for factory, and some for outdoor types, the idea being to give a range in prices in the different styles and finish. One of the features of the lamp is its long life; using a ½ inch carbon it is claimed a lamp will burn with safety between each trimming fully eighty hours. It is very easily trimmed. The trim spring holds the chamber tight to the gas check. To trim the lamp this is pulled down to release the chamber and the carbon put in, very much the same as an old style D. C. lamp. The lamp has a carbon rod which is used on account of the difficulty sometimes found by using a carbon feed. Any uneven or slightly crooked carbon will not stick. The carbon rod allows the lamp to feed more evenly.

NEW ARC LAMP.

The make of the lamp is simple, yet it is strongly constructed so as not to get out of order. The carbons are controlled by a single magnet coil, which has a sheath or iron cover. This cover both strengthens and makes it more efficient, and keeps the coil cool. Opposite the magnet there is a dash pot which allows an easy pick-up when the lamp is starting. The current is adjusted through a reactive coil, and the lambs ordinarily are adjusted to five amperes, unless otherwise ordered.

The inventors have assigned an interest in the lamp to the well known firm of Brown, Boggs & Co., of Hamilton, Ont., who already have filled several orders, and the encouraging results have warranted them in adding an additional three storey building to their factory, which is nearing completion, and they will then be in a position to meet the demand which is being experienced for these lamps.

## AMALGAMATION OF ELECTRICAL INTERESTS.

Negotiations have been under way for some time looking to the absorption by the Canadian General Electric Company of the manufacturing department of the Royal Electric Company at Montreal. No official announcement has been made, but it is believed that the deal has been closed. In all probability the extensive works of the Royal Electric Company at Montreal will continue to be operated. The Royal Company will devote its attention exclusively to the light and power business, the intention being to develop the Chambly power to its full extent.

## MORE LIGHT WANTED.

MONTREAL, Nov. 15, 1900.

Editor ELECTRICAL NEWS:

On page 214 of your November issue mention is made of Messrs. Strickland & Company's "Persuader." Do our good friends object to throwing a little more light on the subject?

Yours truly,

"WIREMAN."

## TESTS OF LIGHTING APPARATUS.

SCHOOL OF PRACTICAL SCIENCE,

TORONTO, December 4th, 1900.

Edit r ELECTRICAL NEWS:

SIR,—In your last issue, on page 207, there appear some comments on "Street Lighting in Toronto" which bear special reference to a series of tests which we have made at the School of Practical Science, for the city, on the various appliances offered under tender to the city for street lighting, and to our reports on the tests. You say truly that our task was not an easy one; and we doubt whether in a short statement it is possible to explain the points involved, but as some of the comments in the article referred to seem not to put the question quite fairly, we wish here to refer to them. The first portion of our report gave detailed information with regard to the light obtained from each of the nineteen different appliances, and its distribution in the various directions, the supplementary portion was prepared in order to meet the requirement of a comparison between the illumination of the streets and the cost of the same in the case of each illuminant; it was not intended to be considered separately. Referring to Palaz' treatise on "Industrial Photometry, with Special Application to Electric Lighting," translated by Paterson, page 294, we find the opinion given, supported also by other authority, that in the lighting of large open areas the mean illumination as well as the minimum should be taken into consideration.

In the second portion of our report we have done this, the first column, the price per candle power, giving information as to mean illumination, and the second the cost per mile lighted up to a given minimum of illumination. Compared in the latter way the results must naturally appear less favorable to all high candle-power lamps, for sub-division of light necessarily improves the minimum illumination. Also from this point of view the arc light is under the disadvantage that the ray which is effective on the roadway at the point of its least illumination (somewhere near 10 degrees below the horizontal, depending on the distance assumed between lamps) is of comparatively low intensity. On the other hand, the arc light makes an excellent showing in the first column (cost per candle), already referred to. It seems not unlikely that these figures may appear "contradictory and misleading," but the fact is that the subject is by no means simple, and there is room for considerable difference of opinion as to the proper method of valuing street illumination.

Referring to the "hydrocarbon lamp with special reflector," the article states, "It seems strange that while on the basis of cost per mile such a favorable showing is made for the hydrocarbon lamp with special reflector the cost of candle power should have been omitted in respect to this particular type of appartus only." There is, however, nothing strange about this omission; the reason this test was asked for was to determine the effectiveness of the reflector for its purpose, a matter fully described on page 11 of our first report. To determine the "cost per candlepower" the mean hemispherical candlepower would have been required. This would have necessitated several hundred more settings of the photometer and have involved much extra work, more, in fact, than time permitted. The value of the quantity, however, cannot be very different from that for the same lamp without the reflector. Again, it is stated that "it is unfair to calculate on the basis of cost per mile of illumination, particularly with the special reflector which throws most of the light in one direction, as most of the lights on the streets of Toronto are on street corners and diffuse light north, south, east and west." The lamp referred to was offered as a tender for low candle power illumination in competition with the Consumer's Gas Company. Of the gas lamps now on the streets, numbering about 960, only about one-quarter are at street corners, so that the question of the allowance for street corners in the case of these lamps is of much less importance than one would be lead to suppose from the statement quoted. The statement can perhaps fairly be used of the arc lights, of which we understand that about two-thirds are on corners; this, of course, gives them the advantage of lighting two extra spaces on cross streets by means of two out of three lamps, or altogether five spaces with three lamps, thus reducing the average cost per mile to 60 per cent. of what it would be if none were on corners. These considerations, as well as the fact that if lights are to be placed in certain definite positions in any case the total cost is proportional to the price of a single light, are so obvious that we did not consider it necessary to mention them.

Again, we find it stated that "another peculiarity of the report is that the point of illumination at which the tests were made was the minimum for the electric light and approximately the maximum for the gas light." This statement we consider to be particularly unfair to our report, implying as it does that we simply made tests at one point on the lamp, whereas the values given for each of the nine different arc light tests for the mean spherical candlepower were obtained from 66 points each, and the mean hemispherical from 50.

In the first part of the report also the values of the horizontal, the maximum candlepower, and that 10 degrees below the horizontal, are stated in each case. Further, as to the fact that the ray which strikes the ground midway between lamps (and therefore must be used in calculating the minimum illumination on the street) is but a poor specimen of the rays from an arc lamp, while it is practically of the maximum strength for a gas or mantle light, that is, as mentioned above, simply the misfortune of the arc light. Finally it is stated that "this extra and increasing light at every other point than the maximum was not taken into account at all." Now, this is exactly what was taken account of in the adjacent column, namely, "cost of candlepower," in which account was taken of all light delivered below the horizontal.

Yours truly, W. H. ELLIS,

T. R. ROSHBRUGH.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building.

MONTREAL, December 7th, 1900.

The late street car accident on Guy street north (Cote de Neiges Hill), caused by the trolley coming off, could have been prevented by having air brake or some similar equipment instead of hand brake, a thing absolutely necessary on long hills of this sort ; further, by preventing the public by some means or other from crowding on the back platform until the front motors are almost lifted off the ground One thing, however, must be remembered, that the Montreal Street Railway Company were forced to build this line, by our worthy city council, against their protests. The line is only to accommodate a very few persons on all days except Sunday, when the line is better patronized by people going to the Roman Catholic cemetery. It is highly probable that this line does not pay expenses.

The elections have come and gone, and were not of especial interest to the electrical fraternity in Montreal. The only point where they are of consequence is in customs duties, and these have been badly assorted under both regimes as regards electrical merchandise in general.

We hear of the number of new cars which the Montreal Street Railway are going to give us, and of the additional horse-power purchased from the Chambly Company, but we still hang on like flies, and the old joke of "there's always room for one more" still stands good.

When we read on page 214 of your November issue about city electrician L. J. Morgan, of Kansas City, we Montrealers can sympathize with the lot of our veteran city electrician, Mr. T. H. Badger, who no doubt has as much if not more to put up with.

It may interest some of the readers of the ELECTRICAL NEWS to know that the systems of barb wire on top of poles as a protection against lightning, described on page 205, was in use between Montmorency Falls and Quebec long before the Chambly transmission was in existence. It may have differed in detail, but the principle involved was the same, and particulars as to its efficacy can no doubt be procured from Mr. Louis Burran, electrical engineer for the Quebec Light and Power Company.

Three Windsor cars, one with a white lamp, second with a red lamp, and third with a green lamp, was a soul-inspiring sight the other evening. The lamps are supposed to designate the line, but possibly the effect of the elections accounts for the red tinge. Double trucks to cars is a recent novelty here ; in fact, if this sort of thing continues we might possibly expect a seat in the cars at business hours in the near future.

One who has tried to open up business relations with firms in Great Britain states that he "gives it up." The delay is simply out of all question ; the order, be it ever so urgent, is numbered and hung on the fyle to go through in regular order, so that in spite of the preferential tariff orders go to the United States. This is not as it should be, but the fault does not lie with Canada.

One of the hardest pieces of luck was the breaking of the dam at Chambly. To add to it, the following day, when numerous temporary circuits had to be run on the poles by the Royal Company, so as to connect with the Lachine Company's sub-station, where a loan of 1,000 h.p. had been arranged for, the weather was magnificent—rain, snow and freezing following each other. Again, before all the temporary arrangements were fully complete, along came a wind storm of 70 miles per hour violence, blowing down a number of important poles, the property of the Royal Company. Although other companies with outside wires were more or less damaged by the wind, the Royal are especially entitled to sympathy under the circumstances. Their outside corps of linemen have been at it night and day, and it speaks volumes for them that steam was got promptly in the reserve station, lines connected, and incandescent and arcs running as usual practically without intermission.

It is rumored that the deal whereby the Canadian General Electric Company takes over the manufacturing department of the Royal Electric Company is "un fait accompli," and why not? The Canadian General have room and can do it, the Royal Electric want room for extending lighting station facilities, and would get it. It would seem a good move for both parties.

The Electrical Workers' Union is the latest thing out, and they assure the trade that they do not intend to countenance "strikes." What about the one in Ottawa ? or has it no connection with this union in question ? One thing is sure, and that is that although the trade in Montreal seems to be jealous of one another, if any such practice springs up they will combine for mutual protection in that direction, and the strike can have but one ending, i.e., disastrous to the employees. As the winter here makes a very dull season, even if successful in a summer strike, the malefactors could easily be weeded out when the proper time came, and the companies generally notified. The "walking delegate," (if we may assume this as his title) who loafed around the Balmoral hotel for several weeks last summer establishing this union, must have had his expenses paid out of the pockets of wiremen, etc., who could ill afford dues for such purposes. First-class wages and all round work for the year are easily procurable here by thorough, reliable and steady wiremen, but rarely do we find a combination of these three essentials. Let the union bring up the standard of the men and wages will rise without effort on their part. Some of the so called wiremen here, would not be tolerated in the United States for 24 hours.

### EVENTS AT MCGILL.

The first meeting of the McGill Applied Science Society for this session was held early in November. A lecture was given by Mr. McNab, engineer of the Victoria bridge, in which he enumerated the difficulties that were encountered in building the bridge and the means that were used to overcome them. A series of advanced lectures for demonstration in the laboratories and for graduates generally has been arranged for. The first of these was given on November 13th, when Prof. Rutherford spoke on "Discharge of Electricity through Gases.

## AMERICAN SCHOOL OF CORRESPONDENCE.

The American School of Correspondence, Boston, Mass., has recently added four new instructors to its staff, all of whom are teachers at The Massachusetts Institute of Technology. These are: William S. Newell, boilers ; Joseph C. Riley, machine design ; Walter S. Lsland, steam engines ; and Frank R. Swift, chemistry. The Canadian interests of the school are presided over by Mr. R. R. Miller, with headquarters at Elliott House, Toronto.

## SPARKS.

The construction of an electric railway between the villages of Schomberg and Lloydtown, Ont., is said to be an assured fact.

Steps are unde way looking to the introduction of the electric light in Weymou N. S. Leading citizens have agreed to take 250 lights.

It is rumored that Mr. J. A. Shibley, of New York, has made an offer for the purchase of the electric street railway system of Kingston, Ont.

The city council of Toronto is desirous of corresponding with persons interested in the formation of a company to build a system of radial electric railways.

Messrs. Harden & Barber, who are at the head of the scheme to build an electric railway from Brighton to Havelock, Ont., have held meetings in several municipalities recently.

Mr. Geo. McAllister, of Bloomingdale, Ont., has purchased a small water power and intends to generate electric power to be used in connection with his saw-milling operations.

At a recent meeting of the town council of St. Marys, Ont., it was decided to engage a superintendent, electrician, and first and second engineers for the waterworks and electric light systems.

Mr. C. Beck, president of the Penetanguishene and Midland Electric Street Railway, Light & Power Company, is again considering the project of an electric railway between Midland and Penetang.

The Bell Telephone Company are extending their system from Quebec eastward. They have just opened an exchange at Fraserville, and are canvassing other towns and villages with the same object in view.

Negotiations are again said to be under way for the absorption of the Metropolitan electric railway by the Toronto Street Railway Company. Should the deal be concluded, the extension of the Metropolitan road may be looked for.

The Listowel Electric Light Company are enlarging and remodelling their power house and installing a new engine manufactured by the Goldie & McCulloch Company, of Galt. They propose suppplying power as well as light.

Mr. M. F. Beach is erecting a temporary wooden building at Iroquois, Ont., in which he will install an electric plant for operating his mill. In the spring it is his intention to erect a stone and brick power house, in which he may install a plant for lighting purposes.

The Royal Electric Company have reconsidered their decision to close down the electric light plant at Orillia, Ont., and are said to have made a verbal offer to expend $10,000 in extending the plant providing the municipality will give a franchise for a number of years.

The Central Electric Company have submitted a tender for lighting the streets of the town of Portage la Prairie, Man., for the next seven years. It has been suggested that the town inaugurate civic ownership, but it is probable that the offer of the Central Electric Company will be accepted.

Mr. J. Keith-Fisher, of the British Columbia Portland Cement Company, Vancouver, has organized a company of American capitalists to establish extensive cement works near Sydney, on Vancouver Island, in British Columbia. The works will have an ultimate capacity of 2,000 barrels a day, and will be operated by electric power.

The Brantford Electric & Operating Company, who have been operating a 180 k.w. S.K.C. machine for the past two years, have found it necessary to increase their capacity for both light and power, and have just started an additional 360 k. w. S K.C. two-phase generator furnished them by the Royal Electric Co., Montreal. This gives them a total capacity of nearly 600 k.w.

It is understood that negotiations have been practically completed for the purchase by Deane & Shibley, of New York, of the electric street railway, electric lighting, and gas franchises of the city of Bellville, Ont. The purchasers are to extend the railway, to reduce the cost of street lighting to $65 per lamp per year, to lower the price of gas 25 cents to $2 per thousand feet, and to supply 1,000 horse power for manufacturing purposes.

## SPARKS.

Mayor Houston, of Nelson, B. C., is advocating the installation by the town of a municipal electric light plant.

The electric light plant at Welland, Ont., owned by Mr. C. J. Page, was totally destroyed by fire on November 26th.

Mr. G. E. Kidd speaks hopefully of the prospects for the construction of an electric railway between Brockville and Ottawa.

Mr. J. F. Webb, of Ypsilanti, Mich., is promoting a scheme for the construction of an electric railway from Windsor to Leamington.

The corporation of Preston, Ont., is considering the advisability of purchasing the electric light plant owned by Wm. S. Fenwick.

The town of Oxford, N. S., is installing a new system of electric lighting, and will do away with their old plant, which is run by water power.

The St. Thomas Street Railway Company, of St. Thomas, Ont., are considering the extension of their road to the lake and in other directions.

The Crow's Nest Pass Coal Co. has ordered a 350 horse power engine from the Robb Engineering Company for its mines at Fernie, British Columbia.

The Ingersoll Power & Electric Light Company have renewed their contract for lighting the town of Ingersoll, Ont., for a furthur term of five years.

The City Council and the Board of Trade of Nanaimo, B.C., are taking joint action to secure the construction of an electric ailway to the Extension Mines.

The shops of the Grand Trunk railway at Point Ste. Charles, Que., will be lighted electrically, the Chambly Manufacturing Company supplying the current.

The Ontario Government is being urged to install an electric light plant in the Parliament buildings, Toronto. It is estimated that the necessary plant will cost about $15,000.

The Institute for the Blind, Brantford, are installing a two-phase K.C.S. motor for power purposes, the current being supplied by the Brantford Electric & Operating Company.

Dr. Thompson, of Cayuga, the owner of the electric lighting plant there, and whose power house was destroyed by fire some six weeks ago, is rebuilding, and has placed his order with the Royal Electric Company for a 750 light alterating current dynamo, with the accessories.

Mr. George Sleeman, of Guelph, Ont., is reported to have sold the riget to manufacture the Sleeman fender in the United States, receiving therefor a lump sum and a royalty on each fender manufactured.

The city of Victoria, B. C., recently received the folllowing tenders for an electric lighting plant at the waterworks pumping station: Marine Iron Works, $548; B. F. Sturtevant, Boston, Mass., $594; Canadian General Electric Company, Vancouver, $800, $850 and $385—three bids; Hinton Electric Company, $475.

The Marmora Electric Light Company have secured an hydraulic power from Messrs. Pearce and are installing a 1000 light alternating current generator, with S.K.C. transformers, etc., from the Royal Electric Company, Montreal. They expect to be in operation before the extreme cold weather sets in.

The Bell Telephone Company have, through the local manager at Galt, Mr. J. N. Taylor, installed a seven station warehouse system for Cowan & Co., a five station for the R. McDougall Co., and a four station for the C. Turnbull Co. The work in connection with the installation was done by Mr. McHugh R. Polson, of the company's staff in Hamilton.

The corporation of the town of Parrsboro, N. S., have taken up the municipal lighting question, and have placed their order with the Royal Electric Company for one 50 k. w. S.K.C. two-phase generator, 500 lights capacity in transformers and wiring supplies. It is expected that the plant will be in operation by the first of the new year.

The Berlin Gas Company, of Berlin, Ont., have renewed their contract for lighting the town for five years. The new contract calls for an all night service. The company recently installed a new Ball dynamo, and are using the latest type of enclosed arc lamps, which are giving good satisfaction. They have forty open and forty enclosed arc lamps.

The Edwardsburg Starch Company, of Cardinal, Ont., whose large factory was destroyed by fire about three months ago, have entirely rebuilt the premises, and are installing a complete electric light and power plant, consisting of two 50 k. w. S.K.C. generators, with switchboards, transformers and motors complete, making it one of the latest and most up-to-date plants in Canada.

The corporation of the town of Newmarket, who four years ago undertook the operation of the electric lighting plant for street as well as commercial lighting, and who at that time installed a complete up-to-date plant, consisting of slow speed condensing engines, S.K.C. generators, and Wood arc dynamo, have found it necessary in order to keep up with the demand for additional street as well as indoor lighting, to increase their plant, and have placed their order with the Goldie & McCulloch Co., of Galt, for a 250 h. p. Wheelock engine, and with the Royal Electric Co. for an additional 100 k. w. S.K.C. two-phase dynamo, with the necessary station accessories and transformers. This town, for its size, will possess one of the most modern and up-to-date plants to be found in Canada.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. XI. JANUARY, 1901 No. 1.

## ELECTRICAL TRANSMISSION PLANT OF THE JACQUES CARTIER WATER POWER COMPANY, QUEBEC.

ONE of the most successful, interesting and up-to-date electrical transmission plants recently installed in Canada is that of the Jacques Cartier Water Power Company, supplying light and power in the city of Quebec—interesting on account of the engineering features of the plant itself, the historic associations and quaint peculiarities of the city, and its predicted commercial importance in the near future.

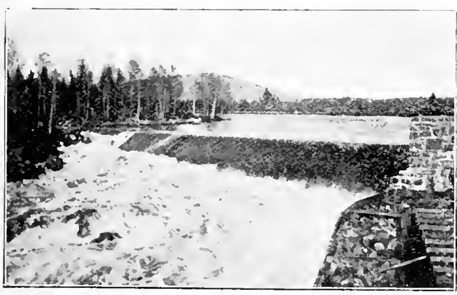

FIG. 1.—MAIN DAM FROM RAILWAY BRIDGE.

The contractors for the whole work were the International Hydraulic Company, of New York, who recently turned over the plant to the Jacques Cartier Water Power Company.

The power house is situated on the Jacques Cartier river, at the rapids of St. Gabriel, 17 miles from the city of Quebec, the normal head being about 32 feet. As the river is here divided by a small island, two dams were necessary; both are substantially built of cribwork, the smaller being 142 feet in length, and the main dam, shown in Fig. 1, 158 feet. The dams raise the river sufficiently to give a level surface for six miles up, thus giving considerable power storage, if it should ever be necessary, and at the same time entirely obviating any trouble from frazil. At one end of the main dam is built a heavy masonry bulkhead, from which the two feed pipes, 13 feet in diameter, lead to the power house, 270 feet below.

The power house, shown in Fig. 2, is of brick, 56x86 feet, and is situated at such an elevation that, at ordinary conditions of the river levels, the turbines are driven under a pressure due to about 17 feet of head above, with a draft-tube vacuum due to about 15 feet of fall below.

Each of the two generators is direct connected to two 54 inch McCormick turbines, manufactured by the S. Morgan Smith Company. These wheels under 30 feet head are capable of delivering 1,710 h. p. at full gate. The water-wheel governors on the large turbines are of the Lombard type. The 30 inch feed pipes for the exciter turbines are fed inside the power house from the main pipes, being arranged with four valves, so that either exciter turbine can be fed from either of the main pipes. A view of the wheel room is shown in Fig. 4. In the spring of this year, two large stand-pipes are to be erected close to the power house, one on each side of the pipe-line, to overcome the inertia effect in the long feed pipes; this effect is so marked that it is not practicable or safe to operate the governors automatically under present conditions, the governing in the meantime being done manually, which, although troublesome, is very satisfactory, the regulation being inside of 1 per cent. each way under varying load.

The electrical equipment of the power house is of Westinghouse manufacture throughout. The two generators are of the three-phase, revolving armature type, of 750 k. w. capacity (guaranteed for 5 hours at 25 per cent. overload), wound for 2,000 volts, 7,200 alternations per minute, at 150 revolutions per minute. The exciters are 37.5 k. w., 125 volt four-pole machines, each direct connected to a single 18 inch turbine, running at 350 r. p. m., and regulated by a small Walsh governor.

The switchboard (Fig. 6) is of five panels, one exciter panel, two generator panels, and two line panels. It is similar to the standard Westinghouse board, but with some additions and changes. Besides ammeters in every phase of each generator and line, there are two Niagara type indicating wattmeters on each generator panel, and a Westinghouse polyphase integrating wattmeter on each line panel. It is furnished with duplicate sets of bus-bars and double throw switches on generators, lines and exciters.

FIG. 2.—POWER HOUSE AND DAM FROM BELOW.

There are two sets of step-up transformers, each of three 250 k. w. units, of the Westinghouse self-cooling, oil-insulated type, raising the voltage from 2,000 to

20,000 volts. These are delta connected on primary and secondary, so that in case of one transformer becoming disabled, the service can be continued on the remaining two units of the same set.

Through the centre of the power house runs a brick

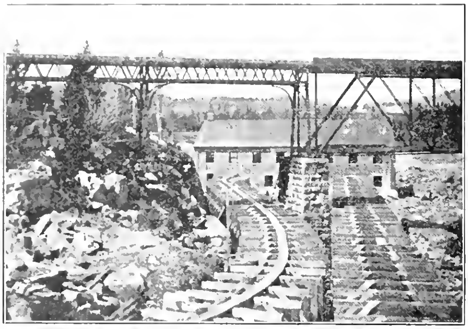

Fig. 3. Power House from Bulk Head.

wall set on a 5 inch masonry foundation wall, beginning below the level of the bottom of the draft-tubes, and running up to just below the floor level, each side of this foundation wall being filled in with rubble masonry up to the concrete under the cement floors. On one side of this brick wall is the dynamo room, containing the generators, exciters, switchboard and water-wheel governors; on the other side on the ground floor is the wheel-room, on the first floor the space is divided into eight rooms, in the largest of which are the step-up transformers referred to above. In the attic are the 20,000 volt combined fuse and circuit breakers and a set of Wurt's lightning arresters, on marble panels, designed also for 20,000 volts.

A unique feature of the power house is that a part of it, the remaining seven rooms referred to above, is used as living quarters for the power house staff, one man being employed as cook. There are four double bedrooms, a dining room, kitchen and bath-room. The arrangement is found to be a comfortable and convenient one. A separate building, also containing a private

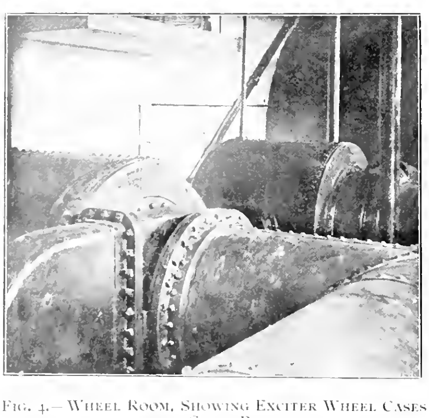

Fig. 4.—Wheel Room, Showing Exciter Wheel Cases and Cross-Pipe.

living room, is fitted up as a store-room and work shop, another building near by being a blacksmith shop.

The transmission pole line is, generally speaking, of 35 foot poles, but where irregularities in the ground occur, or where the line passes near dwellings, the poles are much higher than this; in one case where the line passes along a cemetery bordered by high trees, spliced poles are used, 80 to 85 feet high.

The transmission line is composed of two sets, each of three No. 4 B. & S. hard drawn copper wires, each set being transposed five times. The telephone line is transposed every second pole; in neither case is any trouble from induction experienced.

Just outside the city limits is situated the transformer sub-station (Fig. 8), a brick building with cement floor, containing high potential circuit breakers and Wurts lightning arresters of the same type as at the power house, and two sets of step-down transformers; each set consists of two 375 k. w. units with Scott connection for transforming the 20,000 volt three-phase current to two-phase current at 2,000 volts. The trunk line running from this point to the distributing switchboard, about one mile, is on 60 foot poles, carrying two four-wire sets of No. 00 .B & S. weather-proof wire.

The distributing switchboard is temporarily set up inside the walls of the old fort, in a substantial, though small, stone building, which was originally a powder magazine. This arrangement is made pending the

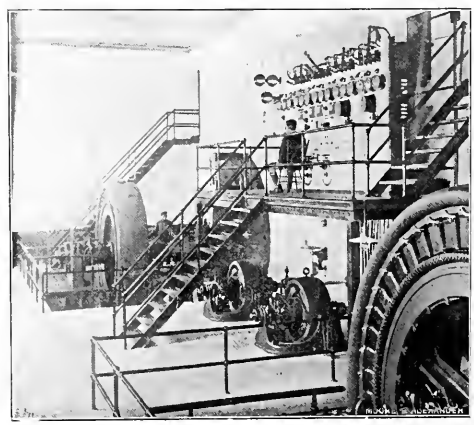

Fig. 5.—Dynamo Room.

completion of a spacious building which the company are about to build, combining the general offices and store-rooms with the distributing station. The building will be situated at about the centre of the city, on one of its most important thoroughfares. The switchboard consists of five panels, two for the two trunk lines, two distributing panels, and one regulating panel. By double throw switches on the line panels the current is switched on either set of distributing bus-bars, on either of which by similar double throw switches on the circuits panels, any city line, of which there are at present eight, may be thrown. On these circuit panels are plugs with flexible couplings, two sets to each circuit, so that in case of a throw over to the other bus-bars no interruption of light need occur.

The regulating panel is equipped with Stillwell regulators boosting 4 per cent. each way. On this panel is also a voltmeter and multipoint switch, to which runs a complete system of pressure wires from two points on each of the main banks of transformers in the city distribution. By the voltage on these pressure wires the regulators are worked, in some cases also enabling the switchboard attendant to detect a blown transformer fuse before being notified by customers.

To correct the power house voltage so as to give

the required pressure at sub-station, two other voltmeters on the regulating panel are used, one on each phase of the lighting bus-bars, the mean of their readings being taken. To communicate with the power house a system of signalling is used, which deserves special notice on account of its novelty, convenience and effectiveness. Choke-coils are connected across the telephone line both at power house and distributing station, having an impedence so high that the ordinary use of the telephone is not affected. The middle points of these coils are grounded, and a relay and key inserted at both ends, ennabling signals to be made even if the telephone line becomes short-circuited, or if one wire be broken. The regular practice is regulation within ½ per cent. each way.

The city is divided into eight districts, fed by separate sets of primaries; in each district there is one or more banks of transformers, feeding a three-wire secondary system, 108 volts on each side. The three-wire principle is carried so far that where many customers are supplied from the same loop, three wires are run to the bracket where services diverge, using 216 volts, thereby giving much better regulation with same amount of

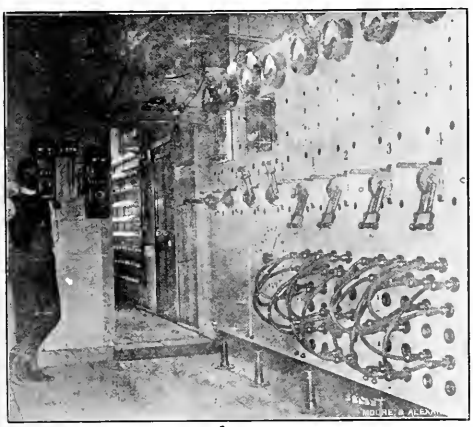

FIG. 6.—TEMPORARY DISTRIBUTING SWITCH-BOARD.

copper. Some outlying districts, of which several have not before had electric light, i. e., St. Louis Road, St. Foye Road, Sillery, are now reached; in these districts customers are supplied mainly from independent transformers. An entirely separate city system is used for the power service, current being supplied at 500 volts. For the purpose of this part of service, the city is divided into two districts respectively, east and west of the distributing station. The indications at present are that this will soon be a very important part of the system.

It will be noticed that the entire plant from power house to distributing station is in duplicate, so that in case of a breakdown in any part, the duplicate part may be used to continue the service.

The transformers, meters and lamps used were manufactured expressly for the company, and on their specifications. Pittsburgh transformers, Westinghouse and Diamond meters and Imperial lamps are the types employed at present.

The transformers have a special winding, the two secondary coils each giving 108 volts, so that a single transformer may feed a three-wire set. They have proved peculiarly free frym lightning trouble, as in spite of the heavy storms of the past summer, not one break-down has occurred. Before being put into service, each transformer is given an eight hour run at full load, iron and copper losses are measured, and ratio tested with a standard transformer. From these tests the

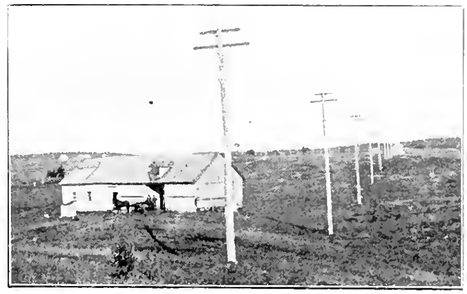

FIG. 7.—VIEW OF TRANSMISSION LINE.

percentage regulation up to full load is obtained. A complete record is kept of every transformer; besides the manufacturer's number, each is given a local number, its position is noted, with number of lamps fed, either from this transformer singly or from the bank of which it forms a part, also the number of lamps on each side of the three-wire system. The record is referred to before connecting up any new installation, so as to keep, as nearly as possible, a balanced load on each transformer, and to avoid overloading. Between each two transformers on the two outside wires of the secondary mains, junction boxes are inserted, thus preventing the crippling of the whole bank should the fuse on one of the transformers blow.

Every meter is tested at various loads, and a complete record is kept on file.

Five lamps from each barrel of every shipment are put on a testing rack and tested every 48 hours for candle power and wattage, and are also run for life. Curves are drawn showing the decrease in candle power and the increase in wattage, and a mean efficiency curve is also drawn, specially noting at what age the lamp crossed the 10 per cent. and 20 per cent. depreciation lines. These curves are drawn for each set of

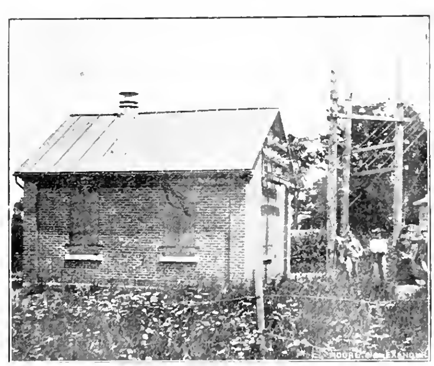

FIG. 8.—STEP-DOWN TRANSFORMER HOUSE.

lamps on test, and the photometer work is done with laboratory precision. The lamps are supplied free on first installations, and for meter customers free renewals. To flat rate customers lamps are sold below cost of any on the market, so as to secure proper service. A

3.1 watt lamp is used on meter installations, and a 3.5 on flat rates. Complaint cards are sent to subscribers, which they may fill in and return in case of any dissatisfaction, and whenever necessary a Bristol voltmeter in portable form is set up on the customer's premises, so that the voltage may be checked up for a few days.

The company is operating under a very keen opposition, but, on account of its liberal policy, coupled with its earnest efforts to serve and oblige its customers,

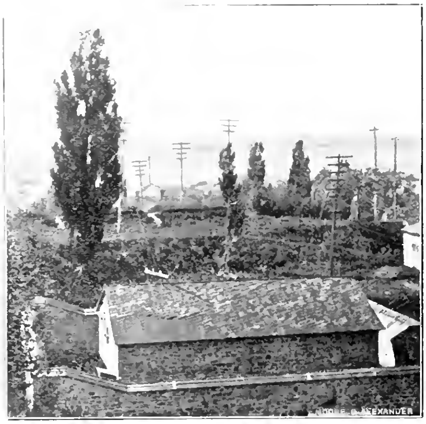

FIG. 9.—DISTRIBUTING STATION.

and the fact that it was the cause of reducing rates about 40 per cent., it has met with liberal support from the citizens. All the poles were specially selected, and the company avoided the principal thoroughfares as much as was practicable. These points alone helped to win the esteem of the public.

The management of the company is in the hands of Mr. Edward Slade, while Mr. G. Hartman is superintendent.

## COMPLIMENTARY DINNER TO PROF. GALBRAITH.

THE assembling of nearly three hundred students and graduates of the School of Practical Science at the complimentary banquet tendered to the worthy Principal, Prof. Galbraith, on December 21st, was a high tribute to that gentleman's personal popularity and worth, as well as to the value of the services which he has rendered to the cause of scientific education in Ontario. Graduates were present from almost every part of the Dominion and from across the line. The arrangements for the dinner were most complete, reflecting much credit upon the energy and taste of the committee.

McConkey's handsome new ball-room was utilized for the occasion. On the walls were 21 shields bearing the names of the graduates of each year since the opening of the school.

Mr. James McDougall, engineer for the County of York, presided, having on his right the Minister of Education and on his left the guest of the evening, besides many other guests of prominence. In the balcony were a number of ladies, including Principal Galbraith's aged mother and Mrs. Galbraith.

There was much handshaking and jollity among the "old boys," who in many cases had not met for years, while the present day students caused many a laugh by the clever bon mots with which they punctuated the remarks of the various speakers.

In expressing his acknowledgment and appreciation of the honor conferred upon him, Prof. Galbraith took occasion to refer to the subject of engineering education, based upon his experience during the last twenty-one years as Principal of the School of Practical Science, and his knowledge of the success of its graduates. He pointed out that while it was plainly impossible within the short space of three or four years to turn out an engineer, architect or chemist fit for the full responsibilities of his profession, a scientific school could furnish its students with advantages which it was worth time and money to acquire. Perhaps the chief object of such a school was to train its graduates to read and appropriate the facts supplied through engineering literature, and to acquire skill of hand, eye and ear by work in the laboratory, drafting room and field. One of the greatest advantages of a ocurse of study in a scientific school was that the mind of the student is almost unconsciously trained in the classification of facts. He cannot attend the various classes for three or four years without knowing to what departments or subdepartments of science the facts of observation are to be referred, and even if he has forgotten how to apply the sciences he knows at least where and how to get the information he requires without loss of time. His course in the school has supplied him with a great catalog of knowledge.

The Principal, in bringing his remarks to a close, made the important announcement that the Senate of Toronto University had passed a statute which provides that the School of Practical Science, its teaching staff, examiners and students, together with the examiners for the degrees in applied science and engineering, shall ex officio constitute the Faculty of Applied Science of the University of Toronto. By this statute the powers of the Senate with reference to the degrees, and those of the school with reference to the work of instruction,

FIG. 10.—VIEW OF CITY DISTRIBUTION.

as also the statute respecting affiliation, remain unaltered. The result is that the University gains, without expense, a fully equipped Faculty of Applied Science, and in this respect puts itself on an equality with the other great universities of the continent; while, on the other hand, the School of Science gains public recognition of the fact that its work is of equal rank and dignity with that of the ancient faculties of arts, medicine and law.

The proceedings terminated with the presentation to Prof. Galbraith of a handsome gold watch by the graduates and undergraduates of the school.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, JAN. 9TH, 1901.

It seems rather a pity that Canadians do not appear to be satisfactory to Canadian institutions. The Canadian Pacific Railway Company, who certainly owe their very existence to Canadians as a whole, have seen fit to give the contract for the electric light wiring required in the new extension being built to Windsor depot, to Edwin C. Lewis & Co., a United States firm of wiring contractors. This was followed up in a more flagrant manner by the Grand Trunk Railway Company giving their contract for similar work to the Western Electric Company, again United States. This case is termed more flagrant because when the city of Montreal ceded the land on McGill street for the new office building (the one referred to), it was distinctly understood that local contractors were to be given the work ; certainly the city of Montreal had no intention of figuring as philanthropists for the benefit of wealthy American firms.

Quite a serious fire occurred in this city recently, due, it is claimed, to high tension current coming in on the interior wiring at the residence of Mr. Hugh Paton on Sherbrooke street. The wiring was done some seven years ago, and for a job of that date is not at all bad. Red core "habirshaw" wire was in use, but unfortunately no main switch. The "fixtures" had been furnished with the old "fibre sheet" insulating joints, and one fixture had been overlooked evidently, as it had none at all. The point at issue, however, is this, why should the underwriters have their inspectors call on small retail stores and other petty risks, and yet not visit private dwellings as well? Surely one is as liable to "electric fires" as the other, and equally worthy of inspection. In this very case no objection would probably have been raised by Mr. Paton as to "expense" had he been requested to bring his installation up to standard ; but it is more than possible the first thing he heard of any "regulations" was after being burned out.

Decorative electric illuminations were few and far between in outdoor Montreal during the late holiday season. What there were consisted of conventional lines of alternated red, white and blue lamps, which cannot be called decorative, and in fact since such have appeared ever since jubilee year, they begin to pall on one. Where lines of lights are used to show the architecture by picking out the outlines of a building they are right enough, otherwise the effect would certainly be more appreciative if worked into heraldic shields, national flags, etc. As this, however, probably costs a little more, it may explain the reason why so many of our shop-keepers decorate electrically, when they do it at all, by hetergeneous strips of everlasting red, white and blue lamps. We understand that some good Xmas tree work was done in some private families when miniature lamps of various colors were interspersed amongst the branches and connected up in series-multiple with the illuminating circuits of the house.

## WHAT IS A "HORSE POWER" (H. P.)—WHAT ITS VALUE OR COST?

By CHAS BAILLAIRGE.

This, in mechanical parlance, is said to be equal to 33,000 lbs. elevated to the height of one foot in one minute of time.

I am led to the explanation of this from seeing that at a recent meeting of stockholders of the Chaudiere Electric Light Co., where an offer was being discussed of so many thousand dollars for so many or so much horse power, no one seemed to have a very clear idea of what a horse power is or of what its value is in dollars.

As a matter for comparison, I explained, in discussing the value of the proposition, that if a horse costs $100.00, at which price an able-bodied animal may be purchased, its yearly value at 5% interest on cost is $5.00. "Now," said I, "a horse is like a loan—a loan is to become extinct, say in 30 or 40 years, and a sinking fund has to be provided of say 2% to pay it off. The horse also will become extinct or cease to be of much use after 10 years, and thus to cover cost of purchase $10.00 per annum has to be allowed wherewith, at the expiration of that time, to purchase another. $10.00 and $5.00 are $15.00. Now, you have to feed this horse, and he will eat in a twelve-month 500 bundles of hay, which, at $5.00, comes to another $25.00. Add again say 26 bushels of oats,a bushel a week or a gallon a day, at 50 cents $12.50 more—together $62.50 as almost a minimum."

Man, by harnessing the powers of nature, as evidenced in waterfalls, by the discovery and application of steam, compressed air, electricity, etc., has given us a substitute for the actual or living horse, and one easier to handle and more economical; but even so, this mechanical horse power costs something, since there are to be allowed for the interest on cost of damming rivers to get the head of water necessary to utilize this element, the interest on cost of machinery and engines.

There is the yearly cost of the horse, for purchase. Dams and machinery wear and are subject to accidents and have to be repaired, and there is the yearly cost for maintenance. The works can last but for a limited number of years, and this is where the sinking fund comes in to wipe out the cost and provide for renewals, and all this, with cost of management, amounts to something. Therefore a mechanical horse power, like the living one, must cost if not $50.00 or $60.00 a year, a goodly portion of this sum. If it only costs $15.00, there is already a tremendous saving, and I have seen it sold for $10.00, representing, say, allowing for leakage and induction, the power to run one arc light of 1,200 to 2,000 c. p., or 5 or more incandescent or series lights of 32 c. p.

Now, the offer made to the Chaudiere company for the balance of the horse power of the falls, after deducting 2,500 h.p. for the electric lighting of St. Romauld, Levis, etc., was less than $2.00 per h.p., and I have never as yet seen or heard of its being valued or sold at less than $5.00. So upon this showing it was decided not to sell, but instead of that to erect pulp works to utilize the surplus power and thus bring in likely as much as $10.00 over 15 or more on the investment, and shares are now rapidly being taken in Quebec to this effect.

What I have just said refers only to the cost of horse power. But what is a horse power? As stated at the head of this article, it is, for purposes of calculation, defined to be 33,000 lbs. elevated to the height of one foot in one minute of time. The object of this mode of stating the proposition is that one of the terms is unity, and that all calculations involving comparison of quantities or the use of what is called "the rule of three" (if one term is 1 (or unity) and as multiplication or division by 1 does not alter the quantity, the arithmetical labour of computation is reduced to a mere operation in simple arithmetic.

But, again, why this mode of stating the h.p? Could not some more simple mode have have been arrived at, something more suggestive to the mind? Yes, and here it is; and a friend of mine, a litterateur, but which does not debar him from an attempt at understanding what is a horse power, wrote me on the appearance of my last work, "Divers ou les Enseignements de la Vie," that never before my explanation of the thing had he been able to understand the meaning of a horse power, thus set forth arithmetically. Of course one will say 33,000 lbs. is not a weight which can be handled by a horse, nor can there occur in practice such a thing as a horse having to elevate that weight to a height of one foot. Well, let us decompose these 33,000 lbs. elevated to a height of one foot into 330 lbs. elevated to a height of 100 feet. This will be made plain to everyone. Hitch your horse to a rope and pulley with a weight of 330 lbs. of brick, mortar, stone, wood, or iron, etc., in the same way as you see them hoisting flour or grain in bags or barrels to the upper stories of a store. The horse will walk 33 paces of 3 feet in less than half a minute of time, and will return again in less than half a minute to be hitched on to another load, and in his horizontal reach of 33 paces or 99—say 100 feet—he will have raised his load of 330 lbs. to an equal height of 100 feet, and 100 lbs. raised 100 feet high is of course the same thing as 100 times as much (or 33,000 lbs.) raised to a height 100 times less (or 1 foot). There, then, you have the performance accomplished, and as the horse can go on doing this for a whole day, say of 8 to 10 hours, the meaning and truth of the assertion is made evident and becomes admissable that a h.p. may be and is equal to its mechanically expressed equivalent of 33,000 lbs. elevated to a height of one foot in one minute of time.

Finally, how was this figure for a h.p. arrived at? The only way in which it naturally should be, that is, by taking a horse and keeping him at this work of hauling up a given weight to a known height, during a day of 8 or 10 hours, and for a week or more, to study his powers of endurance, and by doing so with several horses to get a fair average, and then multiplying the total pounds raised during the 10 hours by the total feet to get what are called foot-pounds, and then dividing the result by the number of minutes in the ten hours (600), thus arriving at 330 lbs., raised 100 feet in one minute, or 33 lbs. raised 1,000 feet in one minute, or 3,300 lbs. raised 10 feet in one minute, or 33,000 lbs. raised one foot = 33,000 foot-pounds.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE : CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.

BRANCH OFFICE : IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2299.

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*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

## CANADIAN ELECTRICAL ASSOCIATION.



**A Hint to Central Station Owners.** "Judicially blind to the fact that an old power house, with board floors well soaked with the drippings of oil for many years, was a veritable tinder box, the directors of the Brooklyn, New York, Rapid Transit Company neglected to insure one of these buildings. After last week's burning the company's guardians now wish they had thought otherwise. A loss of one hundred and seventy-five thousand dollars is a somewhat costly experience."—Fire and Water. How many stations in Canada have oil soaked board floors? How many are properly equipped with fire and lightning protecting appliances? How many are adequately insured?

**Question Department.** A gratifying interest is being shown in our Question and Answer Department. It is hoped that it may continue. Electricians, engineers and others who, in their daily experience, meet with extraordinary experiences or peculiar difficulties in connection with the operation of their plant, are asked to write to this department, giving a full explanation of the circumstances so as to make an intelligent and helpful reply possible. In such cases we shall endeavor, as far as possible, to give a satisfactory solution of the problem, and in this way to make the department of benefit to subscribers. Each reader should make it a point to submit a question occasionally, and also to give his opinion on the questions propounded.

**Electrical Matters in 1900.** THE developments in the electrical field during 1900 were in line with the rapid progress which that industry has made during late years. Perhaps the greatest advancement was in the application of principles already known rather than in the direction of new discoveries. There was a more general employment of alternating current apparatus and enclosed arc lamps. Improvements were made to the Nernst lamp, but they were not of a character to place that lamp in the market as a competitor to the types already in use. Considerable advancement was made in the direction of transmitting messages without wires. In Europe there were some practical applications of wireless telegraphy. The Postal and Telegraph Department of Germany have adopted such a system based on the Braun theory. Towards the close of the year Signor Marconi was reported to be arranging to erect wireless telegraph stations along the route from Great Britain to Australia, to enable voyagers to send and receive messages throughout the trip. Several experiments of telephoning without wires have been tried in the United States, and are announced to have produced satisfactory results. In the direction of long distance transmission of power the year was a notable one in the United States, a successful test having been made in driving a motor situated 153 miles from the source of power. The automobile industry made remarkable progress during the year, the investigations along this line showing that there is a special field for the electrically porpelled vehicle. In Canada considerable progress was made in electrical matters. Two quite important water power projects were carried to completion, namely, those of the Jacques Cartier Electric Light Company and the Canadian Electric Light Company at Quebec. There was experienced during the year an increased demand for electrical goods and particularly for motors, a number of our large manufacturing establishments having adopted electrical power where steam was formerly employed. There was a noticeable growth in the electric lighting industry, this form of lighting being now in use in small villages and towns where gas and oil was until recently employed. The progress in electric railway construction was likewise of a satisfactory character, and the indications at the present time are that the construction of many miles of radial electric railway will be undertaken in Canada in the near future.

An event of no little interest to the electrical fraternity marked the closing days of the year. It was the absorption by the Canadian General Electric Company of the manufacturing department of the Royal Electric Company. These two companies have furnished the electrical apparatus for the most important power transmission systems in Canada, those of the Cataract Power Company at Hamilton, Chambly Manufacturing Company and Lachine Rapids Hydraulic & Land Com-

pany near Montreal, and the West Kootenay Power & Light Company at Rossland, B. C. So far as Canadian manufacturers are concerned, the Canadian General Electric Company, by their acquisition of the Royal Company's works, would seem at the present time to have a monopoly of the manufacture in Canada of apparatus specially suited for the long-distance transmission of power. In addition to the wide range of electrical apparatus and supplies which they have heretofore supplied to the trade, they are now in a position to furnish the celebrated Stanley inductor machines. The taking over of this plant will no doubt prove a great advantage to the Canadian General. It is the intention to continue the operation of the Montreal factory.

## DEVELOPMENT OF WATER POWERS.

At a meeting of the Engineers' Club of Toronto, held on December 19th last, the development of water powers formed a subject of discussion. It was introduced by Mr. A. B. Lambe, Jr., of the Canadian General Electric Company, who outlined the general principles on which power is obtained from water falls. Although purposely elementary in character, his remarks were of such a nature as to give those present an intelligent conception of the subject, and to create considerable discussion.

At the outset Mr. Lambe stated that the initial cost of apparatus for producing a given amount of power was generally greater with water than with steam, but with the former the amount of depreciation was smaller, and fewer and less skilled attendants were required. In developing a power the four vital points to be considered were flow, head, cost of development and market for power. To each of these he referred briefly. In respect to the flow he said that many plants had been found practically useless because the estimated quantity of power available had been based on the maximum flow at the heaviest season, also that the probability of the flow being greater in one year than in another had been overlooked. The usual method of measuring the flow was the miner's inch, which represents 9 gallons per minute, the head not entering into the calculation.

The head of the water available was a most important consideration, as the power, and therefore the value of a given flow, varied directly with the head. For a high head less costly machinery could be employed, because it would be lighter and revolve at a higher speed. It was possible to deliver for use 60 to 70 per cent. of the power in the water.

In Mr. Lambe's opinion engineers frequently overlook the fact that the commercial side of any enterprise is the most important one. The cost of developing water power varies from $30 to $1,000 per horse power. In California a plant designed for 4,000 h.p. was found to be capable of delivering but 300 h.p. in July and August, the months of low water, and, of course, was a failure financially. The financial success of a water power development costing $200 per developed horse power is very problematical; the average cost for plants possessing no unusual characteristics is from $40 to $100 per horse power.

The market for power was a factor requiring careful consideration. Mr. Lambe did not think that new power plants could expect to find a large market among manufacturers already established and using other sources of power, as they are likely to be opposed to displacing their existing apparatus with other and more or less expensive machinery, but must look for their customers among manufacturers likely to be attracted to the place by cheaper power.

The question of apparatus was next taken up. Water motors, he said, divide themselves roughly into the following classes:—1st, bucket engines, rams and pressure engines; 2nd, vertical wheels; 3rd, turbines. The water pressure engines in use to-day are employed mostly for cranes, hoists, dock-gates and capstans, finding their highest development in England and the continent. The vertical wheel is divided into the under-shot, over-shot and breast-wheel; while turbines divide into pressure and impulse wheels. The greater part of the wheels on the market to-day are manufactured in the United States, Italy and Switzerland. Pressure wheels are operated successfully under heads as low as 3 feet, and jet wheels under heads as high as 2,100 feet.

The ordinary plant, the speaker explained, divides itself into reservoir, head race, wheel proper, and tail-race. The question of storing the head water was one which had received much attention. In certain localities some plants are laid out so as to take advantage of the snow when melting in the spring. In California wonderful examples in hydraulic work are to be found, in some instances the water being carried twenty-five miles, through tunnels in the solid rock, through wooden ditches round the mountain side, crossing valleys by conduits suspended high in air, or by siphons winding down one side and up the other, on through wooden conduits buried perhaps 20 feet under the surface, finally plunging almost vertically down the hill side into the wheels through a steel conduit varying from 1/8 inch steel at the top to 1/2 inch thick at the bottom. Incidentally, Mr. Lambe mentioned that a stream the size of a lead pencil under a head of 2,100 feet would, with a wheel weighing sixty-two pounds, give about 20 h. p.

Brief reference was made to the various types of wheel cases in use and to the construction of the tail-race. Then the question of efficiency was taken up. Modern wheels, said Mr. Lambe, would give an efficiency of from 70 to 75 per cent., although some manufacturers claim even as high as 93 per cent.

The governing of water wheels was one of the most perplexing questions. In driving electrical machinery it was necessary to get the speed regulation extremely close, a variation not exceeding 2 or 3 per cent. frequently being guaranteed. The most common method of governing was to vary the gate opening. In some plants the gates are so geared that they cannot be closed quickly, and the flow is thus permitted to stop gradually. Relief valves was another method of governing, while still another was to place a by-pass between the head water of the wheel and the draft tube which is controlled by the governor. Mr. Lambe concluded by giving a brief description of the different governors in use.

Mr. E. H. Keating stated that he was much interested in Mr. Lambe's remarks, in-so-far as they related to the transmission of power, as a company with which he was connected had for some time been looking into that question. Opinions seemed to differ very greatly as to the price at which power generated from water could be delivered at point of utilization, and there was much conflicting evidence as to losses, etc. With steam power the exact cost could be computed. He also brought up the subject of interruptions to transmission lines.

Mr. W. T. Jennings, C.E., said that the first condition to be considered in the development of a water power was the market. It was also necessary to estimate on the minimum flow of water unless there were means of storage. The cost of power, he said, depended on local circumstances, and would be much higher with some plants than others. Take Niagara, for instance, where there is a high head, the cost of the flume was over $2,000,000. As showing the advancement which had been made, he said that eight years ago it was not considered that electric power could be transmitted from Niagara Falls to Queenston in competition with steam. Mr. Jennings was associated with the construction of the Metropolitan electric railway, North Toronto, and stated that after starting interruptions occurred daily for some time. It was found that these were caused by straws being blown onto the wires and by branches of trees falling upon them. Mr. James McDougall also spoke along the same line.

In answer to Mr. Keating Mr. Lambe said that where interruptions occurred in a transmission line it was usually the result of poor construction and incompetent operation, and could be avoided by proper construction and due attention thereafter. The breaking of white porcelain insulators by boys had been a source of considerable trouble, to remedy which some manufacturers were now putting on their insulators an outside brown coloring coat.

Mr. Chipman said that there were many inland steamers where the development of water power was contemplated, but one thing which was lacking was a knowledge of the drainage area. He urged that the Government should authorize a proper topographical survey.

Mr. T. R. Rosebrugh spoke on the subjects of governing and line losses. At voltages of 40,000, he said, there would be discharges and consequently a certain loss even if no power were being consumed. It would take a considerable horse power to maintain the line voltage even if no power were being taken from the line.

Mr. H. F. Duck thought that the difficulty in connection with some water power developments had been that superintending engineers of ability had not been employed.

A unanimous vote of thanks was tendered to Mr. Lambe for introducing the subject.

## POWER PLANT AT MONTMORENCY FALLS, QUEBEC.

By George W. Bowie, H.E.

The power and generating station of the Quebec Railway, Light & Power Company, situated at Montmorency Falls, seven miles east of the ancient city of Quebec, is probably one of the most interesting, instructive and modernized plants on the continent of America. Its electrical and hydraulic equipment, consisting of the dam, pipe line, power house, turbines and electrical machiney, in its present complete and finished whole, is a creditable example of energy, mental and physical, to overcome natural obstacles in construction, and adverse conditions, which is the delight of the present day engineers to combat and bring to a successful issue.

In these days of herculean enterprises it was not to be expected that the energy of the picturesque Montmorency Falls would be exempt from being made subservient to man's use. So that an account of the electrical hydraulic engineering work which has elevated the antiquated city of Quebec to a first place amongst the cities of Canada and the United States for electric car service and lighting, will not come amiss. What makes an account of this plant doubly interesting is the trouble experienced in designing a turbine suited to a high head of water free from noise in operation and complete destruction in a limited time from perforation of all metal exposed to the impingement of the water on the surfaces receiving the full force at a high pressure. It was only after a lapse of considerable time and constant experiment that the present turbines (the first of their kind installed) were designed by the water wheel manufacturers, who have now been able to devise an "Ideal" turbine suited to the requirements of high head water power and free from all the objectionable features that have hitherto existed in wheels running under these conditions.

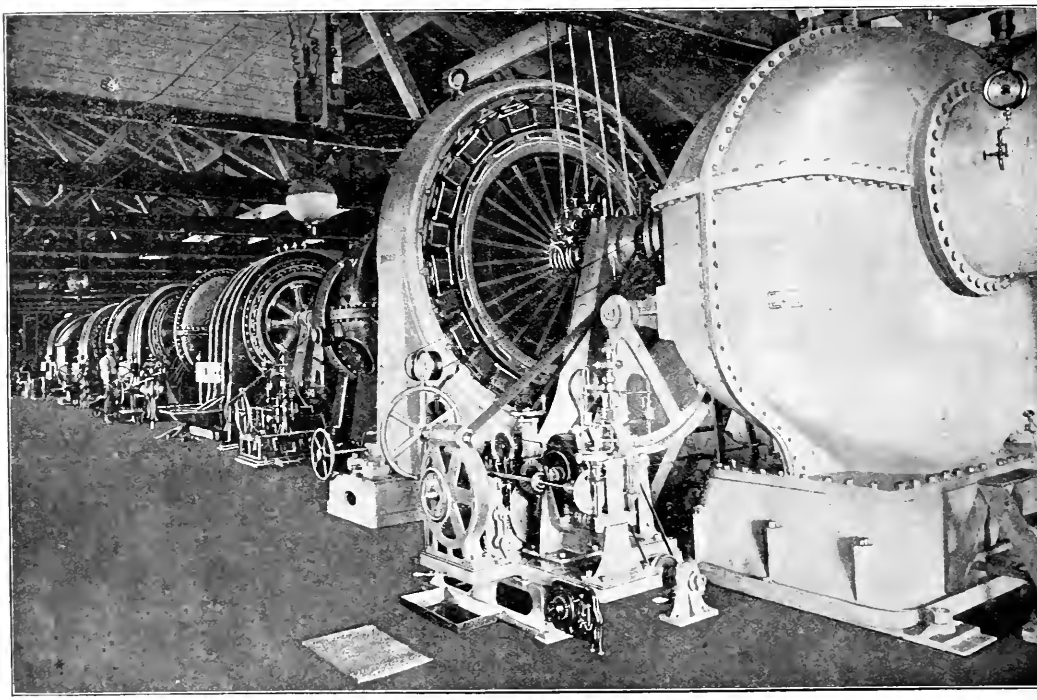

Fig. 1.—View in the Power House, Showing Double-Current Generator and its Turbine in the Foreground.

### SOURCE OF WATER SUPPLY AND DAM.

The Montmorency river has its rise and origin at Snow Lake, about 75 miles from the falls and power station, and drains a considerable area of almost virgin territory, providing an ample supply of water at the dryest season of the year sufficient to develop 10,000 horse power. The dam is built on the verge of the abyss of the famous, historical and well known Montmorency Falls, whose water has a sheer drop of 264 feet into the St. Lawrence river. As useful energy, 200 feet of this fall is utilized by the Quebec Railway, Light & Power Company for commercial purposes in generating electricity. The shape of the dam is rhomboid, the right angled side (facing up-stream) is built of concrete, and is undoubtedly a model of strength, as the conditions made it necessary that it should withstand sudden rises and fast flowing freshets in the river, also the great accumulations of ice in the winter season, which is somewhat prolonged in this latitude. The length of the dam is 265 feet (between shore piers), height 18 feet, thickness at bottom 22 feet, and at top 8 feet.

The gate house dam and abutments contain 4,616 cubic yards of concrete. The mixture of the concrete for interior of dam is 1 of Portland cement, 3 of sand, and 5 of broken stone; for facing, 1 of cement, 2 of sand, and 3 of stone, 12 inches deep from its respective surfaces. A waste water way was also provided to divert the surplus water not used in the feeder pipe while dam was under construction.

At no time during the progress of the work on the dam and gate-house was the generating of electricity under the old system interfered with, the company's engineer and superintendent having arranged, with great forethought, temporary feeder pipes and connections to meet all emergencies arising from the change from the old plan to the new. Another matter which demanded important consideration for uninterrupted winter service was adequate protection against frazil or anchor ice, which is abundant during this period, and would without fail deprive the inhabitants of Quebec of electric lighting and car service. The arrangement is simplicity itself, by isolating an enlargement of the river on its west side (in front of the dam), and building a crib (ballasted with stone) until it reached the entrance, or neck to this enlargement or pond. This crib was 325 feet long, built parallel to the river's course in front of the dam, and contains seven submerged openings 6 ft. x 12 ft. for the admission of water to stilling pond in inside of crib where entrance to feeder pipe is located. This crib or guard pier is sheathed with heavy planking on side next current of river so as to deflect ice and debris of all kinds, thereby remaining in the river's current and passing over the dam. The result justified the expectations of the company's engineer, and has proven an admirable way of getting rid of this winter trouble to a water power plant.

### THE FEEDER PIPE.

The grading for the feeder pipe proved to be no slight piece of work, winding, as it does, snakelike along a steep hillside which

rises to an elevation of almost 300 feet from the St. Lawrence river, sometimes cutting through steep bluffs of rock and again crossing deep and dangerous ravines on the bluff. The feeder pipe is constructed of first grade tank steel, 2,609 feet long from dam to power house, 1,509 feet of its length being 8 feet diameter by ¼ of an inch thick, and having only a slight declination in that distance, the remaining 1100 feet beginning to decline rapidly to the power house, and being 6 feet diameter by ⅜ of an inch thick, the remainder of pipe being ½ inch thick. The seams on the circumference are single riveted. Horizontal seams are double riveted, all rivets ¾ of an inch in diameter.

When all the turbines are running with a "peak load," the rate of flow of the water in the main feeder pipe is 5 feet per second. For such a long length of feeder pipe, containing such a volume of water, it was found necessary to provide means to counteract the fluctuating impetus or oscillation (of the immense quantity of water contained in the pipe) due to the opening and closing of turbine gates, caused by changes of load on generators running both of their railroad systems. For two reasons it was necessary this oscillation should be counteracted; to prevent rupture of pipe, and to allow governors to regulate change of load only, and not to be affected by fluctuations of water, the last reason being a very important consideration for steady service where water is the motive power.

To remedy these faults, it was decided to erect two stand pipes (as being superior to relief valves), No. 1 stand pipe being placed almost immediately outside of the power house. The foundation for the stand pipe was placed 75 feet above power house, and the pipe as erected stands 150 feet high and six feet in diameter, housed from top to bottom with a 4 inch air space to prevent freezing during the winter. No. 2 stand pipe was erected midway between the dam and power house, being 4 feet diameter and 45 feet high. It has a counter fluctuating effect on the action of No. 1 stand pipe. The entire arrangement has proved exceedingly satisfactory, and is one of the many important factors which have resulted in giving steady lighting service, a condition which is the desideratum of electricians and users of the electric current.

POWER HOUSE.

The power house is a substantially built stone structure of two stories, 40 feet wide by 150 feet long, and 45 feet in height from lower floor to apex of roof. The interior being the point of interest, I will proceed with an account, first, of the hydraulic machinery, which has created so much ir ... ticism; this consists of five units for generating current and two small units for excitation. The turbines recently installed are the first of their kind in use, and are designated the "Victor High Pressure Wheel." There is no question, as has been demonstrated by recent tests, but that this is the "ideal" high head turbine, and the builders are to be congratulated on having attained such a perfect wheel, after many trials, vicissitudes and disappointments. At the official test made by competent hydraulic and electrical engineers appointed by the Quebec Railway, Light & Power Co., the turbines at half gate gave an undisputed efficiency of 78 per cent., as shown in the annexed diagram submitted, to which is appended the signature of the company's engineer and manager who supervised the test. The diagram of power, water and efficiency curves as shown are self explanatory, and the interested reader will easily comprehend them without further comment thereon.

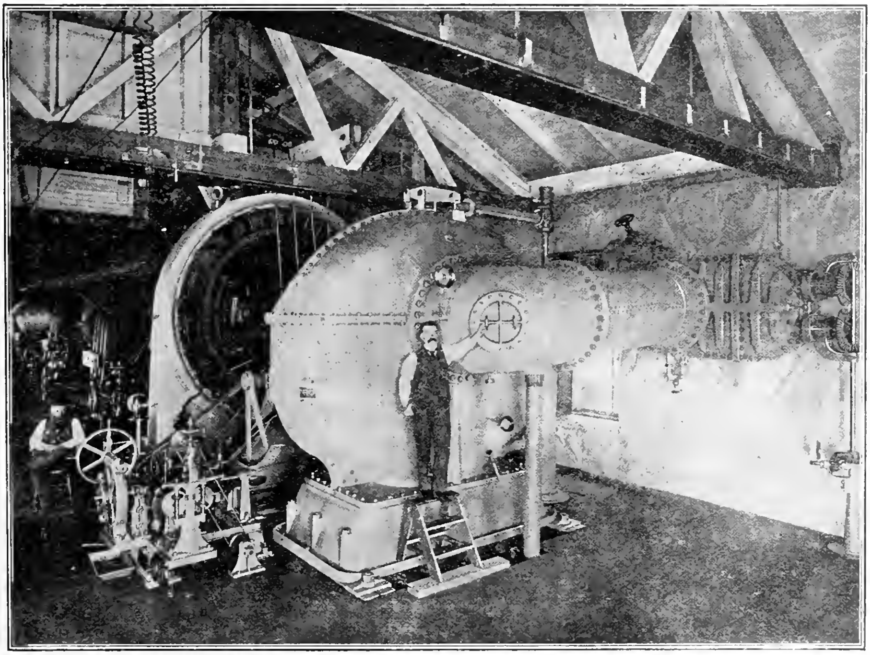

FIG. 2.—1,000 H. P. VICTOR HIGH PRESSURE TURBINE DIRECT CONNECTED TO GENERATOR.

The water wheels or turbines are 54 inches diameter and make 286 revolutions per minute. Each of the five units has a capacity of 1,000 horse power under a head of water 200 feet high. The wheel shaft is coupled direct to generator shaft with flange couplings, with the usual fibre plate and bolt bushings to insure perfect insulation. The bearings on water wheel are of the ring oiling swivel box type.

FIG. 3.—THE HYDRAULIC CRIB.

The wheels when running are free from the noise of breaking water, jar and other detrimental qualities hitherto difficult to eliminate, yet so common in high head wheels, which finally

destroy the wheels by perforating the buckets, chute guides and other parts exposed to the impingement of the water. All parts of the turbine are easily got at for examination. In the design provision has also been made to prevent frazil or anchor ice interfering with the running of the wheels or the operation of the gate in the chute case.

The Victor high head wheel is also provided with an air chamber (situated between wall and case), in which there is a float attached by a tube to an air valve (at top of air chamber) for admission of air to wheel case and draft tube, to maintain a partial vacuum, to retain the water in case of a constant level below the wheel, irrespective of amount of gate opening.

By referring to the illustrations the reader will comprehend the general construction more clearly than can be furnished by explanations.

Close by the wheel settings and attached to each one of them is a 36 inch gate valve, which is provided with a 6 inch by-pass pipe and valve, so as to enable the 36 inch valve to be opened easily by equalizing the pressure on both sides, otherwise they would have to be opened against a pressure of 36 tons. For regulating variation of speed of wheels and generators due to change of load, there is attached to each turbine a Giesler mechanical electrical governor, which governs unerringly, under the most adverse conditions, the electrical load for railroad, motor or lighting purposes. These governors are probably as interesting a piece of mechanism as is constructed at the present day, but to explain the details of the design would require diagrammatic illustra tions, which are outside the scope of this article. With a constantly varying change of load on the street railroad circuit, the Giesler governor on this plant regulates the speed, as shown by the tachometer, within a 3 per cent. variation (in 286 revolutions), and on incandescent and arc lighting units the variation never exceeds 2 per cent. In the event of a line wire breaking, circuit breaker flying out, or any sudden removal of the load, the governor will shut gate within the space of three seconds to a sufficient opening to keep wheel running at normal speed.

ELECTRICAL EQUIPMENT.

The electrical equipment consists of five units, four of the generators being of the S.K.C. system, voltage 5,500, kilowatts 600, alternations 8,000, revolutions 286 per minute. The S. K. C. generators are of the induction type and have proved beyond question that the alternating generator is a most reliable and serviceable system, suitable for the general distribution of light and power simultaneously from the same generator and circuit at frequencies which are economical. The S.K.C. two-phase system has been and is operated under a great diversity of conditions, such as high voltage, low voltage, under and overhead circuits, three and four wires, etc. As has been demonstrated in this plant, the results have been perfectly satisfactory, and since they were placed on their foundations, three years ago, have never given any trouble nor failed to meet the requirements, although in service night and day during that period. These four units are interchangeable, and can be used on any circuit in the city of Quebec from the distributing station there, for incandescent, arc, motor or street railway purposes.

The four S.K.C. units have an independent switchboard which contains nine white marble panels set in an oak frame, bolted to a stable foundation, and furnished with 4 volt-meters, 4 ammeters, and also four rubber shutters, quick arc breaking switches on each outside set of panels, with leads of No. 1 rubber covered wire to each respective unit. The center panels are provided with, on account of there being two exciters, 4 voltmeters, two potential volt-meters, 4 ammeters, also 4 two-throw two-pole switches for excitation purposes, all wiring being arranged to allow of any generator unit being excited from either of the two exciter dynamos.

In addition to the usual or independent switchboard just described, there is a transfer board provided with a suitable bus-bar arrangement which makes it possible to connect each generating unit on any transmitting circuit, between power and distributing stations. The fifth unit, installed within the last few months, is a Westinghouse double current generator, otherwise a direct and alternating current two-phase machine of 600 kilowatts, 400 volts, 8,000 alternations, 286 revolutions per minute. This machine has been previously described in these columns. The alternating current is transmitted to Ste. Anne's de Beaupre, distant only 15 miles, on a 3 wire line. This type of generator is used exclusively for electric railway and long distance transmission purposes. The direct current side of this generator is used to supply current to feed the line running adjacent to the power house by cable feeders with a voltage of 550, being a direct current feeder on the trolley wire where it passes the power house. The alternating current side of the generator delivers the current with a voltage of 400 to the step-up transformers in the power house, which increases the voltage to 11,000, and is transmitted direct to St. Anne's. The step-down transformers there reduce the current to 400 volts, which runs a rotary converter, which feeds the trolley wire with a voltage of 550 at that end of the road. This system has also a feeder from the Quebec city end of the line, and in this way is maintained an almost uniform strength of current and speed of cars from end to end of road.

This unit is provided with a switchboard consisting of 6 upright marble panels, with the usual necessary number of meters and switches. The circuit breakers are of the I. T. E. type. The high potential transmission lines have 3 special automatic combined non-arcing circuit breaking switches.

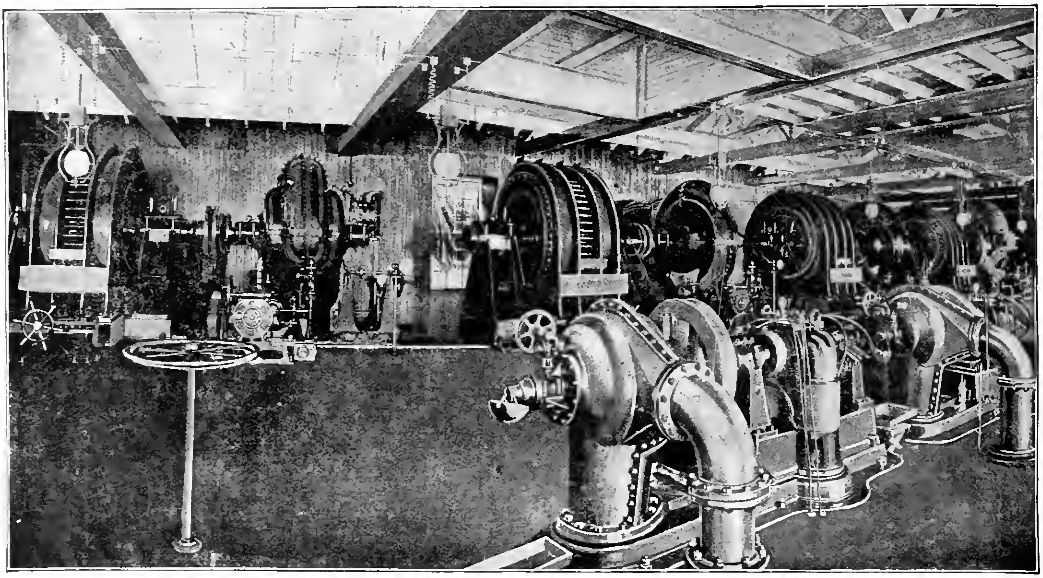

FIG. 4.—BROADSIDE VIEW IN POWER HOUSE—EXCITERS AND THEIR TURBINES IN FOREGROUND.

All of the electrical equipment and apparatus is protected effectively by the Wurts pyramidal form of lightning arresters with choke coils underneath.

The arresters installed here are sufficient for a 15,000 volt three wire alternating current power transmission circuit, and can be used on any number of phases.

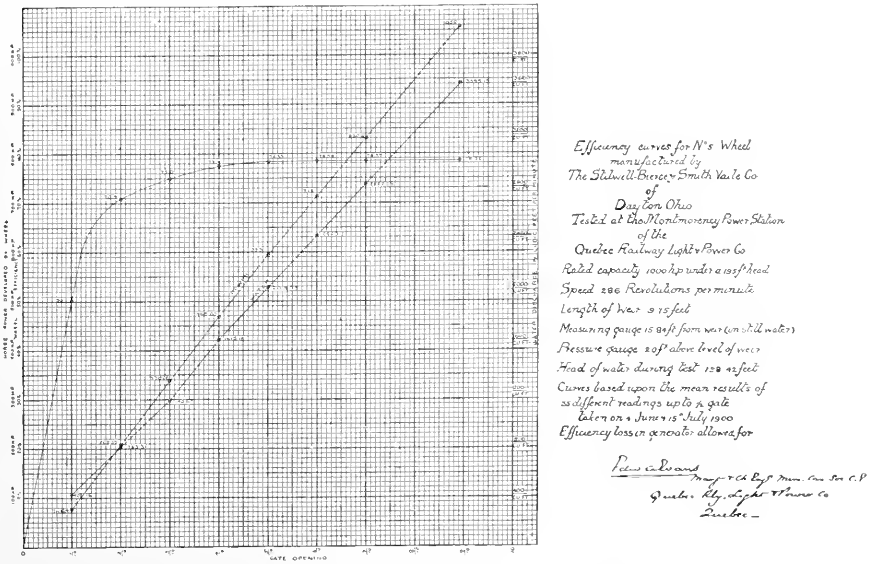


FIG. 5.—DIAGRAM SHOWING EFFICIENCY CURVES.

PERSONAL.

Edward A. Evans, general manager and chief engineer Quebec Railway, Light and Power Company.

Arthur Giesler, H.E. and chief engineer of the Stilwell-Bierce & Smith-Vaile Company, Dayton, Ohio, U.S.A., who are the designers and manufacturers of the Victor high head turbine.

W. A. Langford, superintendent and electrician for the Quebec Railway, Light and Power Company, and Geo. W. Bowie, H.E., who supervised the installation of the hydraulic work for the Stilwell-Bierce & Smith Vaile Company.

Since writing this article Mr. Bowie has severed his connection with the Stilwell-Bierce and Smith-Vaile Company and has accepted a position with the National Cash Register Company, of Dayton, Ohio, as first assistant of their engineering department.

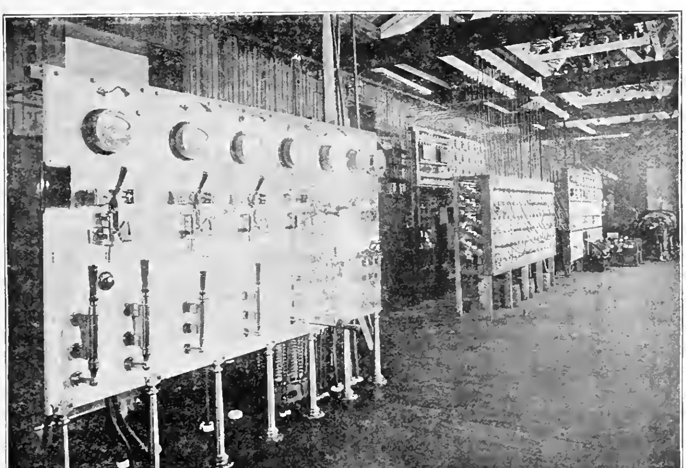

FIG. 6.—THE SWITCHBOARD.

## NEW ELECTRIC RAILWAY.

THE Woodstock, Thames Valley and Ingersoll Electric Railway, which started its first car over the finished section of the road from Woodstock to Beachville on October 8th, has been doing a good business ever since. We understand that often when the car starts there are two or three carloads of people waiting to take it. Other cars will be put on very soon, and as long as the weather will permit work on the line from Beachville to Ingersoll will be pushed ahead. The Von Echa Company, which is building this road, is anxious to finish it without delay, and if not compelled to shut down by cold, will run the cars into Ingersoll before spring. The work so far has been rapid and good, the best of material and labor being used throughout. The roadbed is for the most part built along the upper side of the turnpike, over land purchased in fee simple by the company. Seven foot cedar ties, 2½ foot centre, 30 foot chestnut and cedar poles, and 56 pound rails have been used. The power house is of brick, the car barn frame, and are built on opposite sides of the road, about one mile from Woodstock, but at about the electrical centre of the road, made so on account of the grades.

The adverse criticism which prevailed in many quarters until the car started and demonstrated the correctness of the ideas of the Von Echa Company, has rapidly veered, and now the people are congratulating themselves and the Von Echa Company. Requests are being made for bonds of the road, all of which are held by the Von Echa Company, which showed its faith in the road and in the country through which it is being built, by using its own money, making no appeal for cash, not seeking subsidies or trying to sell either stock or bonds.

The plant as yet is incomplete, only one engine, boiler, generator, etc., having been put in, but duplicate machinery and more cars will soon follow. In the spring freight cars will be added, when the road will be quite a model interurban enterprise, and do much to develop the rich farming country of Oxford county.

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Dr. Moore is building a telephone line from Horning Mills to Whitfield, Ont.

# QUESTIONS AND ANSWERS

"Subscriber" writes: In the November issue of the News you were kind enough to reply to an inquiry of ours under the nom de plume of "Subscriber," re primary effects on secondary wires. In reply to invitations for further particulars we would say that the line had been carefully examined for any swinging contacts, and none such existed. The effect is, however, intermittent; sometimes the same part may be handled with impunity that at another time will promptly knock one down, nor does the weather make much difference, wet or dry. We have not run transformers hot, but have cut one after the other of the 4 banked on this line out, without any difference to the intensity of shock. Not having a static voltmeter, we cannot give the potential, but can, from personal experience, guarantee it well up in the hundreds, also that it is neither static nor a low voltage effect on sensitive constitutions; several hands being severely burned by being pinned to socket or wire while handling same. The line was O.K. till some four months ago, no change being at that time made in it.

Ans.—We have again very carefully gone over your previous enquiry, and also the further details contained above, but regret that we can come to no definite conclusion in the matter. We presume that if you have a series arc circuit, running at the time the trouble was experienced, you have taken the precaution of shutting it down to see if a leak ftom it was not the cause. From your last letter we would judge that the potentials were high, and were not static, as you speak of severe burns having been inflicted. These possible sources being eliminated, there remains but a connection to a foreign line (such as the series arc circuit, referred to above), or to the primary. We would suggest that you obtain the use of a voltmeter with a range at least as high as your primary potential, and that if you fail to discover the trouble with its aid, you put the matter into the hands of one of the manufacturing companies for investigation, as it is not a state of affairs which it is wise to leave unremedied.

"Engineer" says: I have an engine running here with the main belt crossed. Would it not be a better plan to run it the other way, and thus have an open belt?

Ans.—The advisability of reversing the rotation of your engine depends entirely on its make. For instance, if it is equipped with a shaft governor contained by the fly wheel, you will have to get practically a new governor complete before you can run in the other direction, though if you have a pendulum type there will be no difficulty on this score, nothing being necessary but the reversion of the eccentric. Again, if you have a self-oiling type you will probably find it impossible to run it in any direction but that for which it originally was built, as the oil channels, grooves, etc., being supplied as a rule by centrifugal force throwing the oil into them, are adapted to receive the oil but from one direction only, and thus do not get any oil supply if the engine be run the other way. Again, the guides, together with the crosshead adjusting and oiling arrangements, are in many engines designed to take the side thrust of the piston and connecting rods on one side only, and are not designed so that these strains and frictions can be, with safety, transferred to the other guide.

A subscriber at Calgary writes: The purchase of a stone crusher is under consideration. It is expected to crush any size stone usually found in a gravel bed. I may say we have them as large as 14 inches in all directions, and they propose to use electric motive power. The only current available here is the alternating current, and the company are installing synchronous motors, which, of course, require to be brought up to speed by some outside agency, but even if they put in a direct current machine, will not the load be too variable? Will it be either profitable or practicable to run it by electricity, the load varying each time it strikes or completes the crushing of a stone from zero to full capacity of machine? Let it be understood that a heavy fly-wheel will be used.

Ans.—The running of stone crushers can most emphatically be accomplished by means of electric motors. It is of course desirable that all the details of the proposed plant should be submitted for competent investigation, but the following are the main points: Alternating motors are preferable to the direct current type because of their ability, due to the absence of moving contacts, to successfully withstand very large temporary overloads, which will always be encountered in this class of work, owing to irregularity in the feeding of the crusher, the occurrence of hard heads, etc. On the other hand, a direct current type, unless having a horse power capacity very much in excess of that required to run the crusher under normal loads, in which case the installation will become unnecessarily expensive, will give more or less trouble from sparking at the commutator, though this can be partially avoided by careful handling of the plant. We would say that, generally speaking, induction motors would be preferable to the synchronous type, because they will work under much larger voltage variations than will the latter, are easier to look after under the extreme conditions of dirt and dust usually prevailing in such work, are more simple and therefore require less skilled attendance, and will probably cost you less than will the latter. It is of course highly desirable that large balance wheel capacity should be installed, no matter what the motive power, and it is also advisable in order to avoid as much as possible the disturbance of the line voltage incident to the starting of a heavy machine such as this, that the motor be started first, and, after it is running, the crusher brought up to speed by means of a clutch or tight and loose pulleys. The question as to whether it will be profitable to operate your crusher electrically is one governed entirely by local conditions. In the absence of the details obtaining we are unable to give you an opinion; the interest on the cost of the plant, the cost of attendance, the cost of repairs, and the cost of fuel will form the basis on which to calculate the expense of operating by steam or gas or fuel oil; the outlay for electrical operation will be made up of the same components, excepting that the price paid for current will be substituted for the cost of fuel.

E. F. Valiquet, Marlbank, Ont., referring to the question in November number as to which side of a belt should be placed next the pulley, asks whether the flesh or grain side is the smooth side, as he was always told to put the smooth side next the pulley.

Ans.—The flesh or grain side of a belt is the side which has the network of lines running all over it, being the impressions left by the veins and arteries of the animal; the bright, hard, smooth side, with the somewhat pitted or pebbly appearance, is the hair side.

"Dynamo Tender" writes: There are several spots of oil on our switchboard, which I would like to take out if possible. Can you tell me anything which would do for the purpose?

Ans.—The use of ordinary washing soda and vinegar will usually clean out most spots. Lay the marble down flat if possible, put the soda over the spot to be cleaned and pour on the vinegar, thus making the reactions to take place on top of the oil. It is possible, of course, by this means to get at only the oil near the surface of the marble; very possibly the oil which is further in will soak out after a few weeks, in which case the operation will have to be repeated.

The Canadian Electric Light Company, of Quebec, have secured the contract for lighting the streets of Levis, Que., electrically.

Several gentlemen met in Essex, Ont., on December 15th and made arrangements to obtain a charter for the construction of an electric railway from Windsor to a point on the lake shore.

## CORRESPONDENCE.

### BRAKES FOR STREET CARS.

TORONTO, Jan. 3rd, 1901.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR,—In your issue for December last your Montreal correspondent writes you regarding the running away of a car in Montreal city, which had but then recently taken place, and calling attention to the necessity for better brakes.

In connection with this I would point out that with a car equipped with two or more motors and any of the modern type of controllers, the motorman possesses in the reversibility of the motors a brake almost as quick, and certainly as reliable for emergency work as any air or power brake now on the market. If the reversing of the motors with either the trolley on or off will not hold the car, it means that the wheels are slipping, and that the car cannot be held by any style of brake, through its own wheels, but must be controlled by some device such as a track brake, which class of apparatus has not up to the present been commercially perfected.

Yours truly,

A. B. LAMBE, Jr.

### EQUIPMENT OE THE CATARACT POWER COMPANY.

TORONTO, Dec. 31st, 1901.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR,—I picked up in our Toronto office to-day a copy of your CANADIAN ELECTRICAL NEWS for December, and note with interest your editorial on the Cataract Power Company. Evidently you have been mis-informed in some respects as to the apparatus used by this company, as it was not all furnished by the Royal Electric Company. The three 300 k w. rotary converters referred to in the article, with complete switch-board apparatus therefor, was supplied by the Westinghouse Electric & Mfg. Company. We have also furnished to the Cataract Power Company a number of induction motors and transformers aggregating over 1000 horse power in capacity.

I also note with interest your item in regard to the Chambly power plant, in which you mention that it is intended to put in ten 2000 k. w. air blast transformers. It may be of interest to you to know that these transformers and a similar equipment for the receiving station in Montreal are being built by the Westinghouse Company.

Yours very truly,

T. C. FRENYEAR, Manager.

### SELECTION OF ITALIAN TURBINES.

MONTREAL, DEC. 18, 1900.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR,—Replying to your enquiry, I furnish the following information. About three years ago the Cataract Power Company, of Hamilton, decided to develop a water power—267 feet head—for electrical purposes, near St. Catharines, Ont. The design contemplated four units—four horizontal turbines of 1,500 h.p. each, driving four direct connected generators of 1,000 k.w. each, at 400 r.p.m. A contract was awarded to an American company of turbine builders who claimed to be making a specialty of high head turbines. The contract embraced, in part, two turbines, with all necessary valves, supply pipes, draft tubes, governors, etc., erected in place complete; also the draft tubes and foundation works under floor level for the remaining two turbines. The contractors furnished their own designs throughout, and guaranteed the turbines to have a certain efficiency. The instalment was made, but the turbines failed in the efficiency test. As good efficiency was very important to the Cataract Power Company, the turbines were not accepted.

After starting the works the writer made a trip to Europe, and although the trip was primarily for health and pleasure, I took opportunity of visiting some interesting water power developments in Italy, Switzerland and Austria, as well as the works of some of the best known turbine builders. Almost immediately after my return to Canada the Cataract Power Company decided to complete their power plant, but further decided to double the capacity of the two remaining units by making them each 3,000 h.p. turbines and 2,000 k.w. generators. I recommended the company to take tenders in Europe as well as in America for the turbines and their accessories; and acting under instructions from the company, through their manager, I prepared general specifications for the proposed turbines, etc. As the inlet pipes, draft tubes and turbine foundations had already been placed for the smaller turbines, it was important that these, as far as possible, be utilized for the larger, and that the design for the new turbines and the space to be occupied conform, as nearly as possible, to the original designs.

To faciliate matters I visited England, Switzerland, Budapest, (Hungary), and Italy, and got tenders from turbine builders in all of these countries. The result was the acceptance of a tender from Milan, Italy. The turbines have since been received and one has been erected and is now at work. I feel satisfied that the results obtained, in design, cost, efficiency, etc., justified the placing of the contract as was done. Two tenders were received from the United States.

The contractors for the first two turbines the American company subsequently sent their mechanical superintendent to Europe and received, in Switzerland, designs for turbines to replace those first installed. Turbines from the Swiss design have been made and will replace the old as soon as the Italian turbines are fully at work.

I know of no Canadian turbine builders who have had the necessary experience in the design and construction of turbines for the conditions imposed and the very high head of water utilized by the Cataract Power Company, and to this I may add that the American company who made the first turbines were on about equal footing in this respect with the Canadian turbine builders. In Switzerland, Austria and Italy there are many water powers where the head of water is very high—hundreds of feet—but the quantity of water is quite limited. These conditions have led to the design and construction of turbines for high heads to a degree of efficiency hitherto unknown in this country.

The general practice in Europe is to design each turbine for the conditions under which it is required to work. The general practice in this country has been to build the turbine and then adapt the conditions as well as possible to the turbine.

Yours truly,

WM. KENNEDY, JR.

### TORONTO ELECTRIC LIGHT COMPANY.

The Toronto Electric Light Company have recently completed a building 68 x 170 feet, to be used as machine and carpenter and pattern shops. The machinery plant which was used in the company's old machine shop has been installed in the new building, and additional lathes and other machinery of larger capacity will be added. Gallaries extend along both sides of the machine shop and occupy about one-half of the width of the building. The space in these gallaries will probably be used for manufacturing electrical supplies. It may not be generally known that the company manufacture their own arc lamps, switch-boards, and instruments. In the rear of this new building is to be erected a new boiler, engine, and dynamo room to relieve the present dynamo room, which is overcrowded, and to afford space for a new 1,500 h. p. compound engine now in course of construction. The company has been short of engine and boiler capacity for some time past, and are hurrying forward the completion of this additional equipment as speedily as possible. Two new boilers have recently been installed in the present boiler room which will afford a measure of temporary relief.

### EAST TORONTO MUNICIPAL PLANT.

THE village of East Toronto have now their plant in running order and furnishing light to consumers. The street lights, 23 in number, are giving good satisfaction, and the neighboring village of Little York are negotiating for their street lighting from the East Toronto plant. The plant is in a neat and spacious brick power house, built at a remarkably low figure for the size and construction of the building, and contains the Brown engine and boiler and a Canadian General 60 k.w. alternator, switch-board and apparatus. It was at one time the intention to place the plant in a corner of a frame mill, and rent power, but the town council have acted wisely in carring out the the expert's advice and building their own power house. The plant was installed from plans and specifications prepared by H. F. Strickland, electrical expert.

Messrs. Ely & Turner have made a proposition to the council of Wiarton, Ont., to establish an electric ligth plant in that town.

The Dawson City Electric Company, Limited, will apply for legislation to extend the time for the completion of its electric railway.

## ELECTRICAL APPARATUS AT McGILL.

THE following list of apparatus, forming the electrical equipment of the McDonald Engineering Building of McGill University, was received too late to accompany the descriptive article appearing in last issue:

GENERATING PLANT:—One 75 K.W. 125 v., D.C., M.P. generator, Crocker-Wheeler Co., direct connected to a horizontal side crank engine, Robb Engineering Co.; one 75 K.W., 125 v., D.C., M.P. generator, Canadian General Electric Co., direct connected to a horizontal central crank engine, Goldie & McCulloch Co.; one 30 K.W., 105 v., D.C., B.P. generator, Siemens Bros. & Co., direct connected to a vertical central crank engine, Williams & Robinson; one 30 K.W., D.C., B.P. generator, Mather & Platt, direct connected to a vertical central crank engine, Williams & Robinson; one 7 K.W., 110-40 v., D.C., M.P., motor generator, Sprague Electric Co.; one 4 panel switchboard, with instruments, switches, circuit breakers and cell charging apparatus.

A. C. DYNAMO LABORATORY:—One 15 K. W., 220 v., 1-2-3 phase A.C. generator, revolving field type, Canadian General Electric Co., driven by a 40 H.P., D.C., M.P. variable speed motor, Canadian General Electric Co.; one 15 K.W., 220 v., 2-phase alternator, inductor type, S.K.C. system, Royal Electric Co., driven by a 25 H.P., D.C., M.P., variable speed motor, Crocker Wheeler Co.; one 15 K.W., 100-1000 v. single phase alternator, inductor type, Warren Electric Mfg. Co., driven by a 20 H.P., D.C., M.P. variable speed motor, Crockor-Wheeler Co.; one 12 K.W., 100-1000 v. single phase alternator, Brush Electric Eng. Co., driven by a 15 H.P., D.C., M.P., variable speed motor; one 20 K.W., 1-2-3 phase double ended rotary converter, Westinghouse Electric & Mfg. Co.; two 10 K.W., 1-2-3 phase rotary converters, Westinghouse Electric & Mfg. Co.; one 2 H.P., A.C., M.P. motor (S.K.C. system), Royal Electric Co.; one 5 H.P., A. C., M.P., single phase motor, Wagner Electric Mfg. Co.; one 3 H.P., A.C., M.P. induction motor, Westinghouse Electric & Mfg. Co.; one 10 H.P., A.C., M.P. 2-3 phase induction motor arranged as a frequency changer, Canadian General Electric Co., driven by a 10 H.P., D.C., M.P. variable speed motor, Crocker-Wheeler Co.; to vary and regulate speed of motors, field and armature rheostats made by the Cutter Electric Mfg. Co. are provided.

D. C. DYNAMO LABORATORY:—One 16 light, 10 ampere, T.H. arc dynamo, Royal Electric Co., driven by a 20 H.P., D.C., M. P. motor, Westinghouse Electric & Mfg. Co.; one 16 light 10 ampere wood arc dynamo, Fort Wayne Electric Co., driven by a 16 H.P., D.C., bi-polar motor (Edison), Canadian General Electric Co.; one 10 light 10 ampere arc dynamo, Brush Electric Co., driven by a 16 H.P., D.C. bi-polar motor (Edison), Canadian General Electric Co.; one 5 K.W., D.C., M.P. dynamotor, Brush Electric Eng. Co., driven by a 7.5 H.P., D.C., M.P. motor (Victoria), Brush Electric Eng. Co.; one 15 H.P., 500 v., M.P. street railway motor, Canadian General Electric Co.; one 5 H.P., 110 v., D.C., M.P. motor, Royal Electric Co.; one 15 H.P., 110 v., D.C. bi-polar motor, Thomson-Houston Co.; two 3 H.P., 110 v., D.C. motors (fan type), Sprague Electric Co.; one 2-5 H.P., 110 v., D.C. motor, Canadian General Electric Co.; a number of small machines, from 1-20 to 1-2 H.P., of the following makers: Crocker Wheeler Electric Co., Sprague Electric Co., Lundell & Co., General Electric Co.

STANDARDIZING LABORATORY:—Four range 0-0.1-1.0; 0-10: 0-100; 0-600 amperes standard Kelvin balances; one range 0-5,000-10,000 Kelvin electro static voltmeter; one range 0-150 standard Kelvin multicellular voltmeter; one range 0-110 Kelvin multicellular voltmeter; one range 0-1.5-15-30-150-600 standard Weston D.C. ammeter; one range 0-3-150-600-1,500-3,000 standard Weston D.C. voltmeter; one range 0-1,500 ampere 0-3,000 volt potentiometer, Elliott Bros.; one d'Arsonval bi-filar galvanometer, Crompton & Co.; one high resistance Thomson galvanometer for insulation testing; three D'Arsonval galvanometers, Nalder & Co.; one 1.5 standard resistance, Elliott Bros.; one 1-10-15 amp. standard resistance, Elliott Bros.; two standard ohms, Nalder Bros.; one Carhart-Clarke standard cell; one Muirhead's patent standard cell; two Hibbert standard cells, Elliott Bros.; one range 0-11000 Wheatstone bridge, Nalder Bros.; one range 0-2000 Wheatstone bridge, Nalder Bros.; one range 0-100000 resistance box; one range 0-10000 testing set, E. S. Greeley & Co.; one continuously variable voltage transformer for A.C. voltmeter calibration, Royal Electric Co.; one 0 to 8 volt 800 amp. transformer for ammeter calibration; one phase shifter, Westinghouse Electric & Mfg. Co.; one Ewing permeability bridge; one Ewing hysterisis tester; three standard condensors, ranges 1-2-1-1 M. F., Elliott Bros.; one standard condensor, range 0.05-0.5 M. F., Nalder Bros.; one 4.5 K. W. 110-10 volt D.C., B.P. motor generator, carbon rheostats, large capacity potentiometers, etc., etc.

HIGH TENSION LABORATORY:—Four 10 K.W. 200-50000 volt transformers, Westinghouse Electric & Mfg. Co.; one 20 K. W. 200-200 volt insulating transformers, Westinghouse; switchboard with full complement of controlling apparatus, including Stillwell regulator, impedance coils, etc.; one 15000-150000 volt Kelvin electrostatic voltmeter; ammeters, voltmeters, wattmeters, etc.

RESEARCH LABORATORY:—Small A.C. & D.C. generators and motors; constant current transformers of different types and classes; constant voltage transformers of different types and classes; tables for special work, supplied with currents of different kinds and at any desired voltage; a various assortment of special instruments.

OTHER INSTRUMENTS:—Two Stanley hot wire ammeters; two Siemens electro-dynamometers; twenty Thompson ammeters, voltmeters and wattmeters; ten Nalder ammeters and voltmeters; sixty Weston ammeters, voltmeters and wattmeters; two Cardew voltmeters; six recording wattmeters, various types; twenty-five ammeters, voltmeters and wattmeters, miscellaneaous types; four magneto generators with special multi-voltmeters (used as speed indicators), Weston Electric Inst. Co.; six revolution counters; two mechanical speed indicators; contact makers for each A.C. machine; six current transformers; three sets of 64 11 plate type E Chloride accumulators, 25 K.W. hour capacity, 8 hour discharge rating, the Electric Storage Battery Co.; one hundred 3 plate type B Chloride accumulators, for voltmeter calibration, the Electric Storage Battery Co.; one-quarter panel battery switchboard equipped with instruments, circuit breakers, etc.; one-sixth panel distributing switchboard, A.C. and D.C. dynamo laboratories; one main panel switchboard with instruments and circuit breaker dynamo laboratory; twenty-five arc lamps with switchboard; one-fifth K.W. 110/40 v. D.C. motor generator, for charging accumulators, the Crocker, Wheller Co.; seven commercial condersors, adjustable capacity, the Royal Electric Co.; a great variety of transformer and potential regulators; seven absorption dynamometers for motor testing; one transmission dynamometers for motor testing; specially designed tables, wired and equipped with switches, circuit breakers, etc., for each pair of machines (motor and dynamo) to facilitate experimental work.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

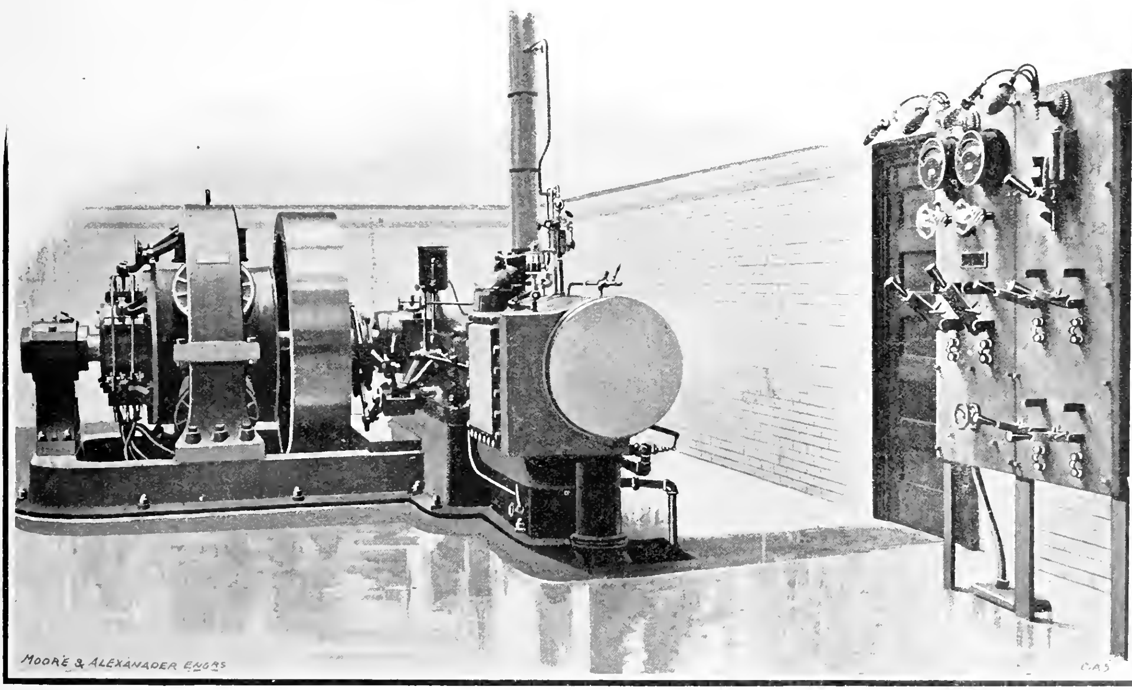
Vol. XI. FEBRUARY, 1901 No. 2.

## ELECTRICAL EQUIPMENT OF THE SUNLIGHT SOAP WORKS.

Messrs. The Lever Bros. Company, Limited, have recently installed at their Sunlight Soap Works, Toronto, an extensive plant for power and lighting. The factory building and offices are most substantial in construction, and taken as a whole, it is probably as well built and complete a factory plant as is to be found in Ontario. Expense has not been spared when the outlay would bring economy in operation and durability of plant. The architects were Messrs. Sproatt & Rolph, Toronto.

The steam plant consists of two Hiene boilers made by the Canadian Heine Boiler Company, of Toronto. The engine is a 13" x 19" x 16" stroke, manufactured by the Robb Engineering Company, of Amherst, N. S. Both valves are controlled by the governor ; the relation of cut-off being so adjusted that an equal amount of work is done in each cylinder.

The electric generator, manufactured by the United Electric Co., of Toronto, is a 200 volt, steel 6 pole machine, rated at 125 kilowatts, and operates at 240 revolutions, although capable of an output of 150 kilowatts at its full pressure of 250 volts, Messrs. Lever Bros. having adopted the standard of 200 volts for their installations in England and other countries. This generator supplies current to a dozen motors throughout the works. These are direct connected by couplings or belted to the various machines, not a foot of main or counter shaft being used throughout the works. The motors are the steel multipolar type, enclosed by hinged iron lids to keep out dust.




Electrical Equipment of the Sunlight Soap Works, Toronto.—View of Engine, Generator and Switchboard.

The arc lamps are of the enclosed type, burning 250 hours with one carbon. The arc and incandescent lamps and motors all take current from the same generator at 200 volts, and the regulation is such that no change in pressure can be noticed in lamps or voltmeter when the heavy motors are thrown on or off.

The switchboard is made of pink Tennessee marble and fitted with Weston instruments and the usual automatic circuit breakers, switches, etc. The office wires are laid in steel conduits.

The United Electric Company, Limited, of Toronto, were the bulk contractors for the generator and engine, and carried out the entire electrical equipment of the works. The generator, motors, switchboard and arc lamps were all manufactured at their Toronto works.

# QUESTIONS AND ANSWERS

"ELECTRICIAN" writes: In reading our wattmeters, which have dials like an ordinary gas meter, I appear to get results ten times too large. Can you advise me in the matter?

ANS.—Your trouble is most likely due to a misconception of the value of the last or right hand dial. For instance, if the amount marked over it is 1,000, it means that one complete revolution of the hand is to be taken as 1,000, not as 10,000, and therefore, if the hand stand over the figure 6, the reading is 600, not 6,000.

A reader asks: What is superheated steam?

ANS.—It is steam heated beyond the temperature at which water at a given pressure turns into steam, this water changing with the pressure, for instance, being 212 Fahr. for the ordinary atmospheric pressure of approximately $14\frac{3}{4}$ lbs. per square inch, and 327 Fahr. for 100 lbs. pressure.

A station manager asks for a receipt for cleaning the inner globe of enclosed arc lamps.

ANS.—If not allowed to get too dirty a stiff brush made for the purpose, and which can be bought from dealers in electrical supplies, is usually sufficient. If washing is needed, a solution of common washing soda will be found satisfactory for all ordinary purposes, though for very refractory cases you will find that a solution of one part hydro-fluoric acid in nine parts of water will make a perfectly clean globe, though, as it acts by cutting away the glass itself, its use naturally tends to shorten the life of the globe.

"G. S.," Hamilton: What is the object in putting onto the switchboard of an alternator two rheostats, one for its field, and one for the field of the exciter?

ANS.—If the exciter is furnishing nothing but the one alternator, and close voltage adjustment is not necessary, there is no very pressing necessity for the rheostat in series with the alternator field, though, by its means, much finer adjustment of the voltage can be obtained than is possible by means of the exciter rheostat alone. Of course, if the exciter is supplying more than one alternator, or doing other work such as running a few lamps, charging a small storage battery, etc., two rheostats are necessary, because in the first case a change in the exciter field rheostat will produce a corresponding change in both alternators unless individually controllable, each by means of its own rheostat, and in the latter the voltage of the exciter is fixed within comparatively narrow limits by the requirements of such incidental loads, and thus cannot be altered at will as it is desired to change the voltage of the alternator. If it is not necessary to keep the voltage of the exciter at any given point, the alternator field rheostat is usually all cut out, when there is but one machine, and the exciter field is then adjusted, by means of its rheostat, to give the desired alternating pressure.

"SUBSCRIBER" writes: I have two direct current compound wound generators, mounted on the engine shafts, and one of them always tries to take more load than the other; we have to move the rheostat all the time to keep the loads anywhere near equal. They are not the same make. What can I do to get over the trouble?

ANS.—The most probable source of the trouble is that the series field shunts are not correctly adjusted. We would suggest that you first try altering these, decreasing the resistance of that on the machine which takes the most load, and if this does not entirely obviate the difficulty we would go into the speed question. It may be that one engine is slowing down much more than the other as the load comes on, or possibly one of them is speeding up as the load rises, or again, it may be that the two machines are operating at speeds varying somewhat from that for which they were designed, which consequently makes the field strengths vary. As a rule, if a machine is running above its rated speed it will tend to take more than its share of the load if in multiple with another running at normal speed.

"R. T.," Montreal: Will you kindly give me the rules for finding the weight of castings by weighing the patterns?

ANS. Iron castings run, as a rule, about 16 times heavier than the pattern from which they are made; brass about 18 times.

A municipal officer writes: We have a three wire direct current system in our town, and are sometimes troubled by the lights on the outskirts getting very dim, though the power house voltage is if anything higher than usual. Our electrician says that one of the machines reverses. What would you suggest as a remedy?

ANS.—If either generator reverses its polarity, the other one not changing, it means that your system is turned into a two wire plant, and consequently your line drop is very much increased, hence the poor light. The simplest remedy is probably to change the field connections of your generators, so that instead of having the field of each machine excited from its own armature, each is magnetized by the armature of the other generator. When this is done, the reversing of either machine will evidently reverse the other also; so that, though the polarity of the plant as a whole be reversed, it still remains a three wire system.

"STUDENT" asks why the reversing cylinder on a street car controller is made interlocking with the main cylinder?

ANS.—Because if it were not it would obviously be quite possible for the car to be reversed with full power on, or some considerable part of it; this would result in a stop so sudden as to be injurious to both the car and those it was carrying, and also because the reversing cylinder is not made to stand any arcing whatever; consequently, if it were opened while carrying current, it would most probably result in the complete loss of this cylinder and the fingers and wiring round it, due to the fierce arc which would be produced under these circumstances.

Christopher Shale, Smith's Falls, Ont., writes: On the 18th of January, in this town, Dr. Young was found dead in his room, having just come from his bath holding the socket of an electric light in his hand against his breast, which was badly burned. The evidence at the inquest went to show that the current at 110 volts had flowed through his body all night. The system probably being grounded some place, the current flowed

rom the shell of the socket with which one of the wire cables inside was in contact, through his body to his bare foot, which rested on the iron grating surrounding the stove-pipe, that being grounded by the water front in the stove on the flat below. We think that as soon as he stepped on this grating he got the shock and was perhaps stunned in falling, but that if he could have fallen free of these connections the first shock would not have killed him. Do you think it would, or do you think that possibly some outside current leaked in? What number of amperes of current strength are supposed to kill a man? What voltage is required to force those amperes through the body, or what is the average resistance of the human body? I enclose herewith the paper reporting the accident.

ANS.—The amount of current required to kill a man is an exceedingly indefinite quantity and cannot be determined even approximately. There are no two men alike in physical constitution or hygenic condition. Many men are capable of receiving with impunity an electric shock that would kill another instantly. A sudden noise or the shock of receiving bad news have been known to have fatal termination. With such people a very slight shock might have bad results, while others in robust health and strong might stand almost any amount with impunity. Instances are not wanting where strong men have sustained for a short time a shocked backed up by five or six thousand volts E.M.F. A person troubled with organic disease of the heart is supposed to be peculiarly susceptible in the matter of an electric shock, and it may be that in the case you refer to that something of the kind was the cause of the unfortunate fatality.

## BY THE WAY.

A VANCOUVER citizen and a New Westminster man conferred together this morning on the subject of electric lighting bills. New Westminster kicked on an account for close on $5 for his house light for November. "How does this compare with your city?" he asked.

"My bill is never more than $2," said Vancouver.

"Not for the winter months?"

"No, not for any month."

"How many rooms have you in your house in Vancouver?"

"Six, with a light in each."

The Westminster man counted up eight rooms in his house, but only four or five commonly used after dark. He says there is no consumption of light that can be avoided. The light is turned off when not required and as there are only three grown people in the house, the bill should be the minimum.

Yet the New Westminster corporation, boasting that their light is the cheapest in Canada, charge the householders $5 net, while a Vancouver man with about the same establishment gets off with less than $2 a month, his light being supplied by a private corporation.

The absurdity of the local system is illustrated by the bills rendered to The Columbian. The workroom here closes at 6 p. m., and the business office at 6:30. Of late there has been practically no work after those hours; and the total lights in place during November were only twelve, yet the bill from the corporation is $13.43 net. This is on the meter system. In The Columbian block there is a single lamp on the straight rate system, lighting the passage to the offices upstairs. This is never turned off. The charge for the continuous burning of this lamp is 60 cents for the month; while for twelve other lamps, burned only up to 6 or 6:30 o'clock, the charge is $1.12 each.

The oft repeated statement that our electric light under civic management is a great success and the cheapest extant, is evidently only a delusion on the part of the aldermen. Weekly Columbian, New Westminster, B. C.

* * *

The "dim religious light" shed by wax candles and the sun's rays passing through painted glass, which has been a characteristic of the great churches of Europe, is gradually being supplanted by the electric glow lamp. A recent despatch from Rome states that at New Years Pope Leo witnessed the completion of an electric illuminating system for St. Peter's and the twinkling of innumerable electric lights beneath Michael Angelo's mighty dome.

## CAR LIGHTING IN GERMANY.

A RECENT rear-end collision on a German road which resulted in a violent explosion of gas from the Pintsch illuminating apparatus on one of the injured coaches has caused a renewal of popular interest in electric train lighting. Experiments are now being made on a train between Berlin and Cologne with the Stone system, in which each car carries a small dynamo geared to a wheel axle, and an accumulator, both hung beneath the floor of the car. This system, the American Electrician states, has proved successful in England, but it is said that the varying speed on the Berlin-Cologne line and the stoppages of the train cause variations and unsteadiness in the light, which the accumulator does not successfully correct. Electric lighting has, however, been adopted for the postal cars, of which there are about 3,000 in Germany. A postal car requires for ordinary service the illumination afforded by about 14 ordinary gaslights, which not only consumed rapidly the oxygen in the car, but in summer made the cars too hot for efficient working of the clerks. For this reason, the electric light has become all but universal in the postal cars of Germany, each of which either carries its small dynamo and accumulator, and thus operates independently, or is provided with storage batteries that are charged from an outside source before the car begins its journey. The storage battery used for this purpose is of a type known as the Bose accumulator, four of which, each containing eight cells, carry sufficient energy to supply nine to 11 12-candle incandescent lights during two nights. Consul-general Mason, from whose report these facts are taken, thinks that the electric system will not come into general use for passenger coach lighting in Germany, because of the expense of making the change, which would involve, besides the additional cost of the new outfits, the discarding of a large amount of costly Pintsch apparatus, no part of which could be utilized.

Mr. Wm. Kennedy, C. E., of Montreal, has been engaged by the town of Perth, Ont., to design a power system for the proposed electric light plant.

The Rogers Electric Company, of Toronto, have installed an electric light plant in the McLagan furniture factory in Stratford, Ont. There will be 370 lights. The work was carried out under the supervision of Mr. F. A. Whatmough, local representative of the Rogers Company.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.

BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
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***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

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**Canadian Electrical Association.**

THE Executive Committee has been called to meet at the Windsor Hotel, Montreal, on the 12th inst. At this meeting the programme of the next annual convention, to be held this year in Ottawa, will be considered, and the preliminary arrangements for the meeting will be made. If Parliament should adjourn early, thus placing at the disposal of the Association the required hotel accommodation, the convention will no doubt be held as in previous years, in "leafy June."

**Municipal Management.**

A GENTLEMAN who has had considerable experience with the management of a municipal lighting plant, while occupying a seat in the municipal council in a Canadian town, expresses the opinion that the only successful method of operating such a plant is by a commission appointed by the council for the purpose. This plan has been adopted in St. John, N. B., and is said to be working out successfully. The gentleman referred to states that every new alderman thinks that he knows more about the management of an electric plant than does the engineer in charge. In pursuance of this belief the aldermen are constantly interfering with the engineer, with the result that his position becomes unbearable and he throws it up. The aldermen on the other hand often hold office for only one year, and so have not the opportunity of acquiring the requisite knowledge to enable them to properly manage this part of the municipal business, so that there is no continuity of management and consequently no profits.

**Great Electricians.**

THE American Institute of Electrical Engineers recently solicited the opinions of its members as to what names connected with electrical science and invention during the nineteenth century would represent the twenty-five greatest electricians of that period, the names to be placed according to rank. Responses were received from 277 members. A majority of the ballots places Faraday in the first position, Kelvin second, Edison third, Bell fourth, Morse fifth, Henry sixth, and Tesla seventh. A second list was complied from ballots of twenty-five professors of electrical engineering, which places Faraday, Kelvin and Maxwell in the first three positions respectively, but a third list compiled from ballots of twenty-five prominent members of the American Institute of Electrical Engineers gives first position to Faraday, second to Maxwell and third to Kelvin. On the general ballot Faraday received almost twice as many votes as any of the others, showing that in the eyes of American electricians at least, he is regarded as having accomplished most for electrical science.

**The Design of Turbines.**

THE introduction into Canada of a pair of Italian turbines, and the reasons calling for such action, is of sufficient moment to demand the attention of Canadian water wheel manufacturers and others interested in the development of water powers. An authority on water wheels has stated that the turbines manufactured in Canada compare very favorably with those made in the United States, but are inferior in point of efficiency when compared with the best turbines manufactured in some European countries. It is claimed that the Italian turbines installed by the Cataract Power Company give a higher

efficiency than any of American manufacture, that the cost was no greater, and that stronger guarantees were given. While for the development of water power with average head and flow, the turbines manufactured on the American continent have been found quite satisfactory, it is claimed that they are not so designed as to give the best results in the case of a power with a high head and limited flow of water. In Italy and Switzerland a larger variety of turbines is manufactured, and it has been the object of the turbine builders there to design wheels specially adapted for the peculiar conditions under which they are to operate. The aim of Canadian turbine builders should be to profit by the experience of these older countries, and to bring their manufactures to an equally high state of perfection. This can only be done gradually. It might be to their advantage to send experts to European countries to study the methods and practices of the best turbine builders there.

**Electric Traction in London, England.**

THE cause of electric traction in Europe is certain to be advanced by the recent decision of the directors of the Metropolitan and Metropolitan District Railway Companies to substitute electricity for steam on their underground system. After delaying the matter as long as possible, these companies have been compelled to recognize the advantages of electric traction. The present decision is claimed to be largely the result of a public demand for the suppression of the annoyances caused by steam locomotives. About four years ago the question was taken up by the Board of Trade, which reported that by far the most satisfactory mode of dealing with the ventilation of the Metropolitan tunnels would be the adoption of electric traction. Another factor which called for the attention of the Metropolitan railway directors was the competition of the Central London Railway, which built the now famous "tube" road, electrically operated, crossing a most important section of the territory covered by the Metropolitan system. The commencement of operations on this road was followed by a decrease in the earnings of the Metropolitan Company. The conversion of the Metropolitan road to electric power is one of the most important undertakings that has ever been proposed. The conditions upon which tenders were invited were purposely of an indefinite character, the object being to permit each tenderer to submit his own plan, and thus to obtain a scheme for the best system of electric traction which modern ingenuity could devise. The contract involves fifty miles of road and an approximate cost of $2,500,000. The awarding of the contract is naturally awaited with much interest. Late advices appear to imply that the proposition submitted by Messrs. Gauz & Company, of Budapesth, has been most favorably considered. As the system proposed by this firm embodies a somewhat novel method of operation, it is intended to have a thorough examination of the system made by the company's engineers, Sir William H. Preece, K.C.B., and Mr. Thomas Parker. Heretofore, it has been the almost universal custom to use direct current for street railway service, since no practical alternating current street car motor was available. But Messrs. Gauz employ the three phase alternating system at the high working pressure of three thousand to five thousand volts. From the central station the wires, charged with a three phase current of 20,000 volts, proceed to converter stations, where the voltage is reduced from three to five thousand volts. It is then conducted to the three-phase motors on the locomotives by a trolley line consisting of two copper wires, the third conductor being the rails. By this arrangement only thin wires are required, thus effecting a great saving in cost of construction. The experimental road at Budapesth was constructed by Messrs. Gauz & Company at their own expense, to demonstrate the simplicity and safety of the system. It has been the subject of much interest to electricians, many of whom have made a personal inspection of it. Besides the firm above referred to, eight other American and European concerns submitted bids for the electrification of the Metropolitan system. They include the Sprague Electric Company, New York; Westinghouse Electric Company, Pittsburg; General Electric Company, Schenectady; Dick, Kerr & Company, London; Mather & Platt, Manchester; Electric Construction Company, Wolverhampton; Siemens & Halske Company, and Schuekert Company, Berlin.

## ELECTRICAL MATTERS IN SYDNEY.

(Correspondence of the ELECTRICAL NEWS.)

The Sydney Gas and Electric Company, of Sydney, Cape Breton, have put in a new 175 S.K.C. machine, having now three in operation. The prospects are that another must soon be installed, as large if not larger than the last one. Business has increased 150 per cent., and now power is supplied to several printing offices. The company is under contract with the town for seven years' lighting. If it were not for this, and the fact that another Company is not supposed to be allowed to do business there, an opposition company would be formed very quickly, as the lighting service on the whole has, we understand, been inefficient, and the improvements to the plant have not kept pace with the great demand for light, nor do they seem to have been made with a view to providing for a rapid future extension, which is sure to come immediately. A large new engine from the Robb Engineering Works, of Amherst, was recently added. The present plant is entirely inadequate. Sydney needs a first-class, up-to-date plant, with modern and improved machinery designed purposely to admit of quick extension. All through last January, it is claimed, it was quite a common thing to have the lights go out several times in an evening, and there were break-downs each week. An indignation meeting was finally held, at which a number of the ratepayers took steps towards the formation of a new company which could guarantee an efficient lighting service.

The equipment of the electric plant in North Sydney has also been seriously defective, with results very similar to that of the plant in Sydney. North Sydney is growing rapidly, and the town should have a more modern plant. We understand new machinery will shortly be added.

The Dominion Iron & Steel Company have a fine electric plant, equipped with modern and well designed apparatus. Most of the equipment was supplied by the Canadian General Electric Company. The large ore-bridge derricks and scoops at the stock piles are driven electrically. At the coke ovens an electric push car of the trolley system runs back and forth and pushes the coke forth when heated.

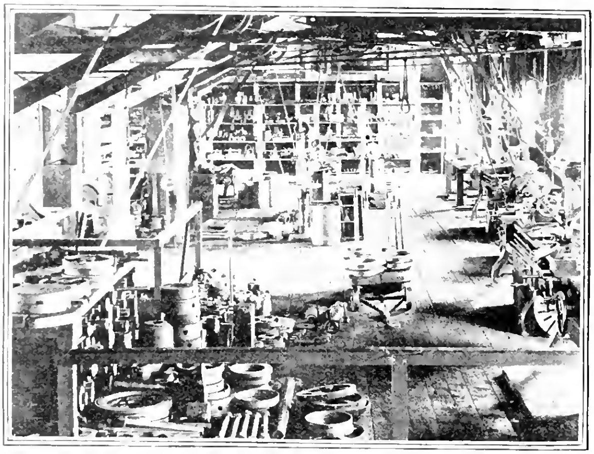
The firm of DeWitt & Mackinlay have opened up a first-class store in Sydney, where they keep a large stock of electrical supplies of all kinds, gas fittings, acetylene gas outfits and general supplies. They opened up there about a year ago, and found a good field, which has developed well and promises even better. Mr. DeWitt is a graduate of Lehigh University, so should thoroughly understand the business. This firm is the only one at present engaged in the business in the town. Among buildings fitted by them are: The new Bank of Montreal, Cape Breton Club, Town Hall, McVery Block, Temperance hotel and many others.

A German professor by the name of Rosenberg has invented a system of wireless telegraphy which he claims is an improvement over that brought out by Marconi. The professor's idea is to reduce the size of his transmitter and receiver so that it may be carried in one's pocket. This would enable a person, so it is claimed, to walk along the street or sit in his office and communicate with his home.

## A CANADIAN ENGINE WORKS.

A visit to the works of the Robb Engineering Company at Amherst, N.S., where the well-known Robb-Armstrong engines and Munford boilers are manufactured, was made a short time ago by Mr. Norman Patterson, who contributed an article to the Canadian Magazine giving a brief description of some of the processes of manufacturing engines as practised in these works, together with several interesting illustrations. After a brief historical reference Mr. Patterson says :

First I visited the draughting department, which may be termed the brain of the institution, since it controls and directs the muscular activity of the establishment, and in the large collection of drawings showing every minute part of each engine, we find a counterpart of the human memory. Every bit of knowledge and experience in engine designing and building acquired by this engineering company, as well as that learned and adopted from the work of others since engines were first built, is here stored, the diagramatic and written records being corrected from day to day, as new experience is gained. The draughting department, by means of blue print impressions made from original drawings or tracing linen, directs every man and boy in the establishment what to make and how to make it. Every workman is provided with these small blue print drawings, containing exact directions and minute measurements for the piece he is required to make. These blue prints, after being once used in the shop, are placed in large envelopes with indicator diagrams showing the performance of the engines while working, and other records, and the number and location of the engines built from them. These envelopes are then filed in a large safe as a permanent record of each engine produced.



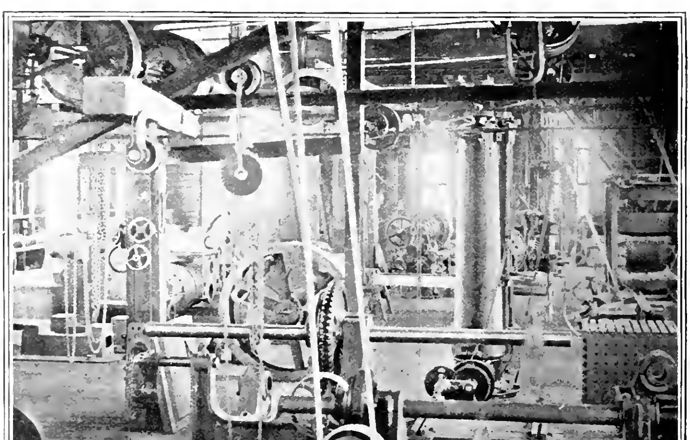
A CANADIAN ENGINE WORKS—CORNER OF THE STOCK ROOM.

Proceeding from the draughting department to the machine shops, one is at first confused by a mass of moving machinery, revolving, reciprocating, slow, fast. I stopped before a man who seems to have no use for machinery, but who is industriously scraping a piece of iron with a hand tool. I am told that this man's business is to "make the crooked straight and the rough places plain," the machinist having found that in machinery as in other human affairs there is no such thing as absolute truth, and the nearest approach to "truth" in a flat surface of iron is produced only by the old and slow method of hand scraping. It is interesting to observe the process and the results of this laborious operation. When a piece of iron, such as the steam valve or crosshead of an engine, which has been plained in a machine, is applied to an instrument called a surface plate, the machined surface is found to be all hills and hollows which have to be reduced by repeated scrapings and trials to the surface plate. The surfaces having been brought to comparative truth, it is curious to find that when one piece of iron is laid upon another, the "trued" surfaces refuse to come together, the upper one floating on the film of air between them for some time or until the air has had time to escape. But when the air has made its escape, it is so thoroughly excluded from between the "trued" surfaces that the pressure of air on the outside of the plates, which, it will be remembered, is about fifteen pounds to the square inch, holds the plates together so that when the upper is lifted, the lower one follows.

In a similar manner round surfaces, such as journals of engine shafts, are made as true and smooth as possible by grinding with fine emery wheels which revolve at a high rate of speed while the shaft revolves slowly, and by careful burnishing and polishing.

Why, I ask, is it necessary to take so much trouble to get the flat and round surfaces true? Because the wear of machinery is due entirely to want of "truth." When the journals and sliding surfaces are made "true" and kept "true," and if the area of surface is large enough to sustain the weight or strain without squeezing out the oil, the metals will be completely separated by oil, so that they will not touch each other and run smoothly on the oil without wear. But if they are rough or even slightly out of truth, the high places project through the oil, producing friction and wear. As an illustration of this, I was shown some surfaces which had been running together for months or years without wear, as was proven by the marks of the cutting tools being still visible.

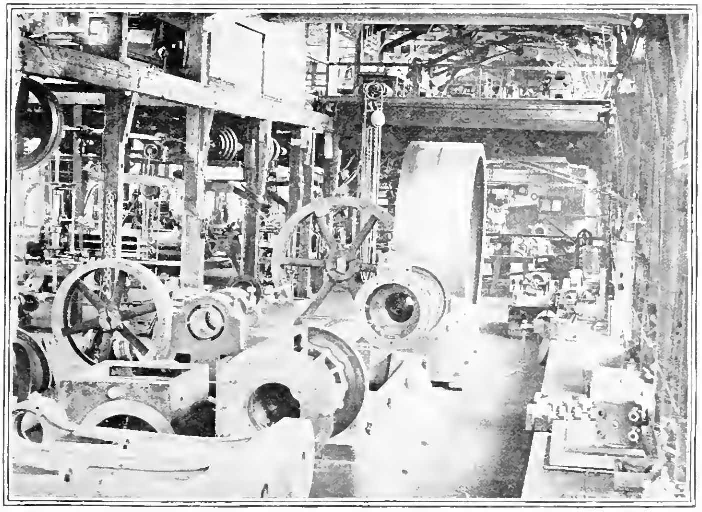
In this department I was also shown some illustrations of the minute and accurate measurements necessary in this class of work, when conducted on the interchangeable or duplicate system, by which every similar piece of a machine is required to be exactly alike, within a limit in some cases of one quarter of one thousandth part of an inch. When a pair of straight edges, which, like the surface plates, are of cast iron scraped accurately straight on one edge, are laid together and placed before a window, it is not possible to see a glimmer of light between them, but when a fine hair is laid between them at one end light could be seen about three-quarters of the way along between the straight edges. This hair was then measured by a little instrument called a micrometer calliper, which is ingeniously arranged



A CANADIAN ENGINE WORKS—PORTION OF THE MACHINE SHOP.

to measure thousandths of an inch as easily and more accurately than the ordinary divisions of an inch, eighths or sixteenths, can be measured by the ordinary rule. The hair was shown to measure about two thousandths of an inch, and as I was able to see light about three-quarters of the length of the straight edges, it was evident that the eye is capable of seeing light through a space as small as half a thousandth of an inch. All measurements are made by the standard steel guages, which are warranted by the makers to be correct within one ten thousandth of an inch.

In walking about through the shops I saw many interesting machines designed especially for manufacturing the engines made here. In almost every case several operations are performed at one time on each machine, so time is saved, and the machined surfaces are made as true as possible with each other without special care or adjustment, as the machines perform this work automatically.



A Canadian Engine Works—Portion of the Erecting Shop.

As an example of several operations being performed simultaneously by one machine, I noticed a large machine which had enfolded in its steel embrace a large casting, which seemed to my unaccustomed eyes to constitute nearly the whole of the engine, but which I was told is called the engine frame. This machine was "facing-off" the end of the engine frame to receive the cylinder, boring the guides where the crosshead is to reciprocate and boring the main bearing to receive the crank shaft, these operations all proceeding at once under the care of one workman. Another machine was turning and boring engine wheels or pulleys, three tools being operated at once in this operation, and the hard cast iron was being turned off so rapidly that the chips of iron were hot enough to burn the hand.

After being conducted over the boiler shops, foundry and pattern shop, I finally arrived at the testing department, which contains large foundations arranged for receiving engines of any size, with steam connections to the boilers and condensers, pony breaks for measuring the power, indicators for taking diagrams of the action of steam in the cylinder, tachometers for indicating the changes of speed, apparatus for weighing the steam used by the engine, by means of which it is possible to subject an engine to all variations of work, and to test its speed, regulation, consumption of steam and general performance before it leaves the works. Every engine, large and small, is tested in this way; working parts are carefully adjusted, valves corrected and indicator diagrams taken, which are filed away with the drawings and other records of every engine that is built.

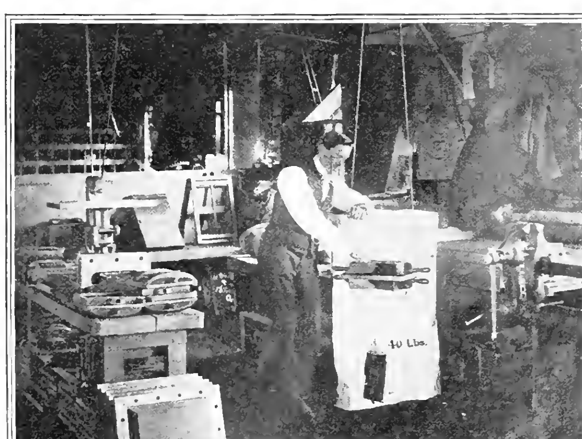
I was much interested in an explanation of a new system of automatic cut-off and regulation for compound engines, by means of which the steam is distributed and expanded so that under all changes of load, no matter how sudden or variable, the regulation of speed is instantaneous and the work equally divided between the high and low pressure cylinders. This system of governing was developed at first by Mr. E. J. Armstrong, M. E., of New York, who organized the engine department, and has been elaborated and adapted to the present form of the engine by Mr. A. G. Robb, the mechanical superintendent of the works.

It occurred to me that perhaps many of the readers of The Canadian Magazine, like myself, although we read and hear much of compound and triple expansion engines, did not really know what is meant by these terms, and having the advantage of the friendly guidance and instruction of the superintendent of the works, thought it a good opportunity to obtain this information. It was explained thus:

Steam is a gas under pressure, produced from water by heat. The more heat the higher the pressure. Of course, the higher the pressure the greater the amount of work a certain volume of steam is capable of performing.

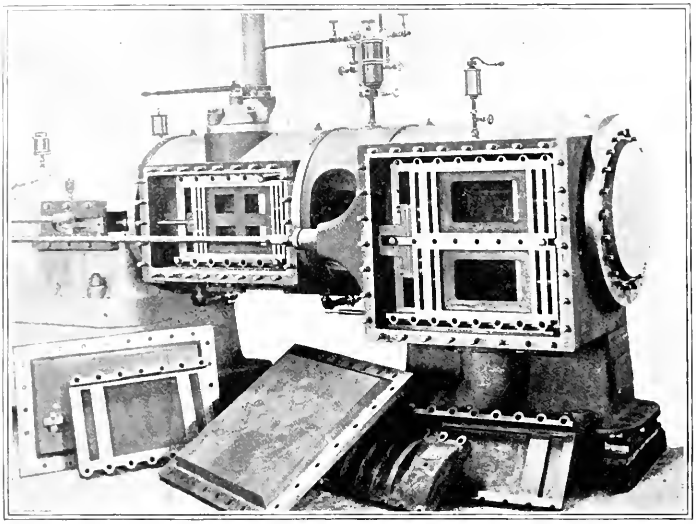
The study of all engine designers, from Watt down to the present, has been to utilize as much of the pressure of the steam as possible before allowing it to escape. This is accomplished by allowing the steam to expand in driving the piston of an engine. If steam was allowed to fill the cylinder full of high-pressure steam at each stroke, and then escape at full pressure, much work would be lost, whereas, if the steam is only allowed to partly fill the cylinder, or to flow into it during a part of the stroke of the piston, and the supply is then cut off, it will expand, still exerting some pressure and doing work until it expands down to the pressure of the atmosphere into which it escapes.

As the art of steam engineering advanced, it was found that the greatest possible economy in the use of steam was obtained by raising the pressure in the steam boiler as high as possible, because it does not require as much heat or fuel in proportion to work done with a high pressure as with a low one, and by getting as much expansion out of the steam as possible; but further experience and investigation showed that when steam was expanded beyond a certain point in a single cylinder the cooling effect on the interior surfaces of the cylinder was sufficient to almost offset the gain by expansion. For instance, steam at 100 lbs. pressure to the square inch has a temperature of about 338 degrees




A Canadian Engine Works—Surface Plates Held Together by Air Pressure.

[F]ahr., while the same steam if expanded down to atmospheric pressure has a temperature of only 212 degrees, the same as boiling water. The difference being 120 degrees, or more than the difference in the temperature of the atmosphere on the coldest day of winter and the warmest day of summer, it will readily be seen that when the interior of the cylinder is subjected to this

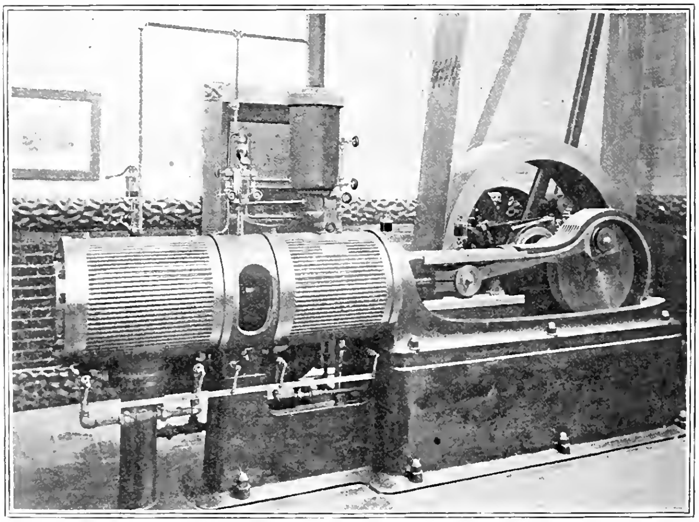


A Canadian Engine Works Cylinders of 300 Horse Power Compound Engine.

great difference it will have a tendency to cool the hot steam while entering, and to be cooled itself by the expanded steam before it is expelled from the cylinder. In order to overcome this loss, the steam is used in two or more cylinders consecutively, being first expanded partly in one, and then used over and further expanded in another cylinder, so that the variation in temperature in each cylinder is much reduced, and the economy of steam correspondingly improved.

A two-cylinder engine, intended for the use of steam at 100 to 125 lbs. pressure, is called compound; a three cylinder engine, intended for a higher pressure of steam, is called triple expansion; and so on for higher pressures, until we have quadruple and quintuple engines.

Before taking my leave I enjoyed a brief visit to the model engine-room of the works, where I saw a beautiful, smooth-running engine which drives a large part of the machinery, and which I was told is a duplicate of three engines sent to Barcelona and Madrid, Spain, where they are used for an electric tramway.



A Canadian Engine Works 125 Horse Power Engine.

"Lightning-rods seem to be out o date." "Yes, the business was run into the ground long ago."—Philadelphia Evening Bulletin.

An automatic telephone pay station has been tried on board the Hamburg-American line steamship 'Augusta Victoria,' at the pier in Hoboken. All that is necessary to be done to connect the steamer with the telephone system is to insert a plug in its proper place on the desk. This is the work of a second. No attention from the telephone company's employees is required. The connection is made with the Hoboken central office. The system gives passengers leaving for Europe opportunity to transact business up to the very moment of sailing, as it is designed to disconnect the telephone at the same moment the lines are cast off.

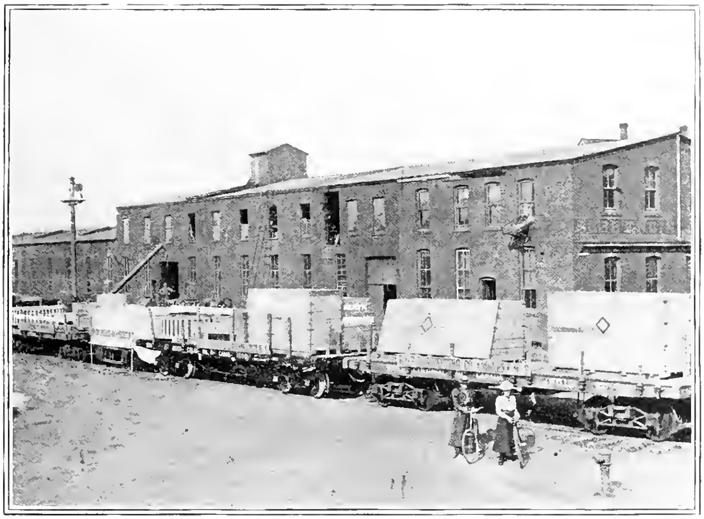
## A ROARING PHONOGRAPH.

According to the London Daily Mail a phonograph that shouts so loudly that every word can be heard at a distance of ten miles has been tested at Brighton. You can whisper a sentence into the machine's small funnel-shaped mouthpiece and it will repeat it in tones that are more deafening than the shrieks of a liner's steam siren. Yet every word is perfectly articulated, and a shorthand writer ten miles away can take down the message as easily as if you were dictating to him in a small room. The machine is the invention of Mr. Horace L. Short, of Brighton. In appearance it is merely an ordinary phonograph, with a large trumpet measuring 4 feet in length. Inside this trumpet there is a small and delicate piece of mechanism that looks something like a whistle. This is the tongue of the machine. Instead of the 'records' being taken on wax in the usual manner, a sapphire needle is made to cut the dots representing the sound vibrations on a silver cylinder, and when the needle travels over the metal a second time the vibrations cause the whistle to produce a series of air valves, and the machine becomes a talking siren which transforms the human voice into a deafening roar. The experiments were made near the Devil's Dyke, Brighton, where the inventor has his workshops. The instrument was placed on the roof of the laboratory, and was made to repeat a number of sentences. At a distance of ten miles the sounds were plainly heard by a large number of people, every word being perfectly distinct, and at a second trial with a favorable wind it was found that an unknown message could be taken down in shorthand at a distance of twelve miles.

The Indians of the Mohauk reserve are evidently keeping their eye in trim for possible contingencies, judging from the large number of glass insulators broken from their pins on the poles the G. N. W. Telegraph Co., through the Indian reserve. Between Shannonville and Deseronto, a distance of about nine miles, over 400 glasses had to be replaced this week. The cross arms and poles in many places are scarred and marked with stones. The road this summer received a coat of gravel, providing the mischievous with convenient ammunition.

## A MOVING PLATFORM FOR RAILROAD STATIONS.

A NOVEL device for a moving platform has been suggested by John Perry, president of the English Institution of Electrical Engineers. He proposes to place at each station of the underground road in London a turn-table about 500 feet in diameter. This turn-table is kept continuously revolving at such a rate that



A CANADIAN ENGINE WORKS. SHIPMENT OF ENGINES FOR ENGLAND AND AUSTRALIA.

its rim travels at the same speed as the moving train. At the centre of the turn-table is a spiral staircase, which, being in the centre, of course, moves more slowly, by which the passenger reaches the main floor. He then walks towards the circumference. The speed at which he is being carried along gradually increases, until at the edge he is travelling at the rate of the moving train, which he here finds seemingly at rest, and with the doors open. He enters, and as the moving platform is left behind the doors are automatically closed until the next station is reached, when they are automatically opened again. With such an arrangement, the track, of course, at each station would be built on a curve closely following that of the turn-table for about half the latter's circumference. Mr. Perry thinks that with this system it might be expedient to have a continuous train on such roads as the underground of London, or the elevated of New York city, so that no matter when a passenger might arrive he would always find a car open and apparently waiting for him. N. Y. Evening Post.

## ONE OF THE FIRST AUTOMOBILES.

QUEBEC, Jan. 10, 1901.

Editor CANADIAN ELECTRICAL NEWS :

DEAR SIR,—In looking again at yours of the 3rd inst., in relation to my paper on "The Progress of the 19th Century," I find that you are kind enough to say that you were interested to learn that I was one of the original inventors of the steam vehicle, and would be pleased if I would give a more detailed description of the apparatus. You go on to add that in view of the recent development in this direction, a description and illustration of my invention would be interesting.

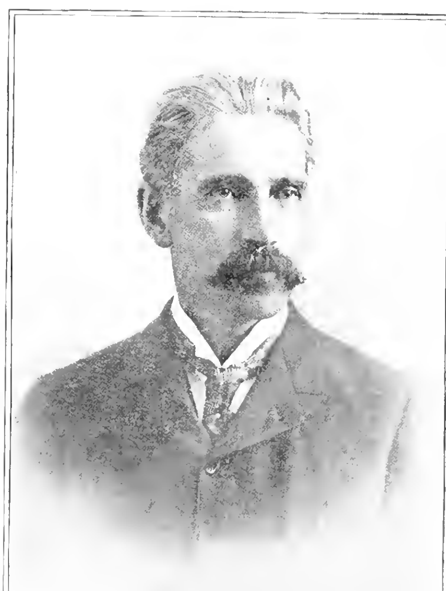
Now, Sir, I have at the present time but a feint remembrance of Trevethick's steam coach for common roads, and I suppose you would like to know in what I declare my vehicle to be an improved one compared to his. It is this, if I remember well, that while Trevethick's motor was a single engined one without a fly-wheel to get it over the "dead points" when it happened at an impediment in the roadway, my machine was a double cylindered one, whereby, the cranks on the axle being at 90 apart, the dead points were got over by one of the pistons being only half way on its travels, while the other was at the turning point and thus capable of exerting a force necessary to overcome any inequality in the paving or macadam. The twin engines were of the ordinary "working beam" type, with parellel bars at one end engaging the cross-head of the piston rod working in guides as usual, while a connecting rod at the opposite end of the oscillating or working beam engaged the crank on the axle or shaft of the vehicle on which the wheels of the automotor were mounted, while a third wheel of less diameter, and capable of running in under the carriage to which it was attached by a bar twining or a swievel, was used to steer the waggon and turn it when required end for end in a radius of a very few feet.

This vehicle, as stated, I built in 1844, working at it after hours and on holidays, as I was then a pupil at the Quebec Seminary. I was helped at it by another boy, one Federick Holt, since burnt at the fire of an old Quebec theatre, and whose father, a German, was for several years organist of the French Cathedral, now the Basilica, Quebec.

It may be foolish now to say so, but I was ever so much pleased when on letting steam into the cylinders for the first time, I found I had placed the eccentrics so exactly as not to require their position to be altered in the least to admit and cut off steam at the absolute moment of time necessary to prevent any loss of power whatever by back pressure.

The two engines were built entirely by ourselves, including the drilling of every hole and the making of every screw, bolt and nut in the whole concern ; while all we got done by outsiders were the boiler, a horizontal one some 2 feet in diameter and 3 feet long with a 15 inch fire flue within it, and the three wheels, which we had made by a regular wheel-wright.

The cylinders were, I believe, about 3 in. inside diameter or less, and some 8 in. to 9 in. long, the pair developing under steam at 30 lbs. pressure about one horse power or more, which



MR. D. W. ROBB

President and Chief Engineer Robb Engineering Company.

drove us along the road at from 8 to 9 miles per hour, the weight upon the driving or bearing wheels being hardly more than 1,200 to 1,500 pounds all told, or with from 2 to 4 persons in the vehicle. I need hardly add that, of course, it was in no way comparable to the automobiles of the present day.

# ELECTRIC RAILWAY DEPARTMENT.

## ELECTRIC RAILWAY IN NEWFOUNDLAND.

By R. F. Markill.

Newfoundland abounds with small and large fresh-water ponds, many of which are so situated that, with very little expense, they can be turned into valuable sources of power. About eight miles from St. Johns, high in the hills which form the rugged coast line of the island, are a number of these ponds, emptying into the sea at a small fishing village called Petty Harbor, and here it is that Mr. R. G. Reid, of Montreal, the great land proprietor and railway magnate of the island, has built the power-house for the electric transmission plant that, on May 1, 1900, began to supply energy for the operation of the first electric railway system in St. Johns—the system of the "St. Johns Electric Railway."

Fig. 1. Power House, Showing Iron Pipe Line from Wooden Flume.

At present only two lakes have been dammed, one having an area of 25,000,000 square feet and the other 1,000,000 square feet, making a total of 26,000,000 square feet. Besides these two reservoirs now in use, there are two others within close proximity having areas of 9,000,000 and 31,000,000 square feet, respectively. A dam and gate are at the mouth of the larger lake to regulate the flow of water, as is required, so that there may be no waste.

From the mouth of the smaller lake a wooden flume 3468 feet in length, carried along the side of the hill, conducts the water to a point 187 feet above the power-house. It is constructed of native spruce 8 ft. x 8 ft. framed timbers on 3 ft. centers, planked on the bottom with 2½ inch and sides 2 inch. The flume practically ends in a rock tunnel 368 feet long, cemented at the junction. Not any lining is used inside, the rock being sufficiently water tight. At the other end are located the pen-stock and gate. From here a pipe 318 feet long, 6 feet 6 inches in diameter, brings the water into the power-house below. This pipe is made of steel plates ⅜ of an inch thick, anchored to concrete pillars, twenty-two in number, embedded in solid rock. Two anchor bolts five feet long, riveted to the sides of the pipe, run through the basin and are bolted to timbers at the back.

The generating station is 138 feet long by 24 feet wide, constructed of native blue stone, with wooden roof covered with sheet iron, cemented floor, and well lighted by large windows. At present only two generators and one water-wheel are installed, but everything is ready for placing another wheel of the same capacity and also two more electrical units. The wheel is of the turbine type, having a rated capacity of 1868 horse power when operating under a head of 187 feet. The wheel is regulated by an electrical governor. On the shaft is a nine-ton fly-wheel, made up of sheet steel plates, bolted together and turned in a lathe. Two Westinghouse generators are directly connected to the water-wheel, one on either side. They are rated at 600 kilowatts each, revolving armature, three-phase type, running at 237 revolutions per minute, and delivering 500 volts at 60 periods per second. Two exciters furnish the field current for generators and lights for the station. They are directly connected to a 50 horse-power turbine, one on either side of the wheel, arranged in the same manner as generators. They have a capacity of 15 kilowatts each, four pole, 110 volts, 605 revolutions per minute. An interior view of power house is shown in Fig. 2.

The switch-board is the ordinary Westinghouse type, consisting of four white marble panels, two for the generators and two for the exciters, with the usual number of ammeters, Niagara-type wattmeters, voltmeters and a Mershon compensator for loss on the line. The current is conducted from the switchboard to the primary side of the step-up transformers on twelve 500,000 circular mil lead-covered tables. On each transformer is mounted a Westinghouse 500-ampere quick break switch for the purpose of opening the primary side if necessary. Three Westinghouse transformers of 400 kilowatts each, oil cooled, raise the voltage to 15,000 volts for transmission. They are connected in delta. From the secondary side the current goes through six high tension pole switches and circuit breakers to the bus-bars and thence to the pole switches connected to the line circuits. The Worts lightning arrester is used. These are installed in loft at the end of the building over the high-tension switches.

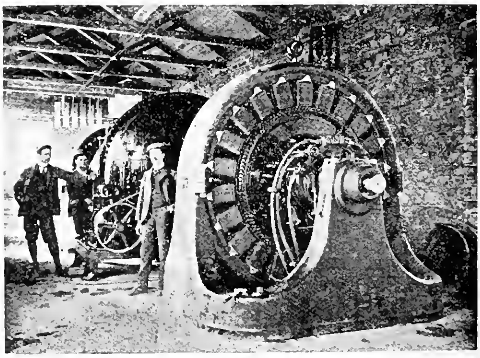


Fig. 2.—Interior of Power House.

### POLE LINE.

Current is brought into St. Johns over two pole lines, in order to insure against interruption of the service. The poles are about 125 feet apart; three wires of No. 5 B. & S. medium drawn on each line, Locke three petticoat glass insulators and locust wood pins, boiled

in paraffine wax, are used, as they are believed to give best results where there is so much fog and rain. There is one cross-arm on each pole, with a pin at either end and a pin in the top of the pole, thus forming an equilateral triangle. The wires are not spiraled. A telephone line connects the generating station with the sub-station, wires being transposed every four poles.

The sub-station (Fig. 3) is at the west end of the city, just beside the dry dock. In appearance it very much resembles the power-house, being constructed of the same material and having a concrete floor, etc. The dimensions are 90 feet long by 30 feet wide. Line wires enter the end of the building through high-tension pole switches similar to the one in generating station, thence to the high-tension bus-bars and distributing switches to four 100-kilowatt Westinghouse oil-cooled transformers for two rotary converters. The transformers are connected Scott system, giving a two phase current at 400 volts. The sub-station also contains four 150 kilowatt transformers, giving two-phase currents at 2040 volts, used for city circuits. The high-tension switches are pole-switches with fuses, each having a marble slab with an air gap of 3 inches between slabs and a shield of asbestos 38 inches by 30 inches. Two

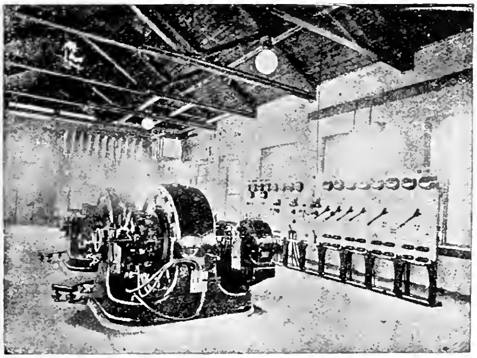


Fig. 3.—Interior of Sub-Station.

rotary converters are at present installed, but foundations are ready for two more. These converters are rated at 200 kilowatts each, speed 720 revolutions, and 500 volts for street railway circuits. The switch-board is of white marble, nine panels in all, four of which are used for the rotary converters and one for railway feeders, the remaining four for light and power, two panels for each. All station appliances are of standard Westinghouse types of latest forms. The remaining interesting feature of the sub-station is that the Manhattan series alternating enclosed arc system will be installed immediately for the street lighting. This will necessitate the addition of one more panel to the switchboard.

The rolling stock of the St. Johns Electric Railway consists of six cars, 32 feet long, equipped with Westinghouse "12a" 30 horsepower, series-parallel, 38 controllers. Four of the cars are double-enders. Two sweepers are provided for the winter season. The track is narrow gauge, to be in keeping with the Newfoundland Railway, which has a gauge of 3 feet 6 inches. Five miles of 50-lb. T. rails have been laid and cars are running over them every day; also, 5700 feet of 83-lb. girder rails on the principal street, which at present is being paved. The trolley wire is No. 0 and suspended from poles on either side of the street. Rails are bonded in the usual way and cross-bonded every 400 feet, No. 0 bonds used for 50-lb. rails and 00 for 83-lb. A number of very steep grades are encountered, one short grade of 14 per cent. and several of 7 and 8 per cent. Two or three curves of 45-ft. radius are also met with. As can be imagined, the cars, motors and trucks have had a severe test, but notwithstanding that they have stood it admirably. The cars and trucks were made in Montreal, the former by the Lariviere Car Manufacturing Company and the latter by the Montreal Switch Company.

The city has a population of 35,000 people, of which the majority are interested in the fishing industry. Quite a lot of manufacturing is done, and as coal is very expensive there is a good demand for electric power.

Mr. C. H. Massy is consulting engineer, Mr. W. A. McKay is superintendent and electrical engineer, and Mr. F. H. Wing is electrical engineer in charge of the generating station at Petty Harbor; while Mr. R. F. Markill is in charge of the sub-station. To these gentlemen is due the credit of the building and operation of this highly successful installation. Journal of Electricity and Gas.

## LIVERPOOL MARINE ELECTRIC RAILWAY.

There has recently been installed in Liverpool, Nova Scotia, an electric marine railway of quite a novel character. The electrical equipment was supplied by the Royal Electric Company, of Montreal, and was installed by the Maritime Electric Co., of Halifax N. S.

The equipment consists of a 30 h. p. induction motor, the motor shaft being geared to a heavy worm shaft and wheel; the worm wheel shaft carries a pinion wheel which gears into another large wheel, on the shaft of which is placed a large heavy sprocket wheel; over this sprocket wheel the heavy two inch chain meshes into heavy sprocket teeth. This chain hauls the vessel up on a cradle over a track projecting out into the River Mersey to a distance of 500 feet, on a grade of ½ inch to the foot. The track and cradle are built in a very solid and substantial manner, being constructed of heavy pine timbers. The concrete foundations and heavy hardwood gear frame, as also the track and cradle, were built and erected by Mr. A. W. Bowcher, contractor, in Liverpool, N.S., and the work is certainly a creditable piece of construction.

Mr. G. C. Siebert, manager of the Maritime Electric Co., spent two weeks in Liverpool installing the plant, and on Friday, January 11th. the first vessel was hauled up and lowered down again, all the apparatus and gear working in an entirely satisfactory manner.

It is interesting to note that Liverpool possessed the first marine railway in the Maritime Provinces, the motive power used being horses. It formerly took from 4 to 5 hours to haul up a vessel, whereas the same work is now performed in 20 minutes. It is also interesting to note that this railway is, without doubt, the first one in America and probably the first one of its kind in the world to which electrical energy has been applied as the motive power.

The installation has been watched with the keenest interest by those connected with Maritime affairs, all of whom have expressed themselves as being highly pleased with the installation.

As a general proposition, advertising pays. There are qualifying considerations. It must be good.—Advisor.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building.

MONTREAL, February 7th, 1901.

A couple of items in the daily press lately are worthy of note: 1st, the notice of a trolley wire having fallen on a team and teamster, the former being killed, but the latter being "protected" by his wet clothes, which the paper informs us, acted as an insulator. 2nd, another daily voicing its views on the late destructive fire at Thos. May & Company's, says: "It will probably never be known what caused the fire, but no doubt it was due to electric wires." (When in doubt, blame electricity.)

It is possible, but highly improbable, that the late fire in Thos. May & Company's was electrical. The fire, it is admitted, started about 10 p.m. Now, the establishment in question closed at 6 p.m., and it is rather unlikely that it should smother until then, especially as the factory portion of the establishment has considerable wooden benching, partitions, etc. Again, it the office clerks were back after hours they would have used gas, as the electric light installation was not extended to the ground floor. So far as the motor circuit is concerned (250 V. D.C.), the wires entered by a window, on top floor and the interior circuit ran only about 12 feet to where the motor was located, same being duly provided with a D.P. J.K. switch. The electric lighting outfit was limited in its area, and was "open cleat" style, and not of an ancient type. The chances are far stronger that the fire can be laid down about the sewing machines (run from shaft) under bench, as actually was the case in the former Bernier & West fire; the daily news putting it to electricity, notwithstanding proof.

The Royal Electric Company suffered most severely in the late May fire, one of their principle pole lines full of various circuits coming up McGill street having been cut. The Montreal Street Railway came next, having to direct their traffic from the busy Windsor route. The water covered their tracks inches deep with solid ice, which later took a small army to clean. The Bell Telephone Company also had an aerial cable cut. The Royal Company only suffered very slight detention, as their line-men, in spite of the severe cold weather, were busy as bees.

Your correspondent is informed that Mr. Walter Grose, hardware merchant, of Montreal, contemplates shortly turning out incandescent lamps from the factory in Hamilton in which he is interested. The Shelby pattern of lamp is to be the type produced, and it is claimed that machinery is now all delivered.

It has not yet been stated that the $3,500,000 fire was caused by electric wires. Why? It started in premises of Saxe & Co., it is said, and he had a hoist motor and some lights. True, they can prove their main switch near inlet to have been opened, but a trifle like this should not stop some ubiquitous "daily." Also, where the missing employees worked on top flat, gas was the illuminant. Another case where the actual cause will be hard to discover on account of the extreme wreck; some may say electric, but think it will be as hard to prove as many a similar puzzle. Quite a lot of valuable electrical installations and apparatus were lost in this fire, particularly the plant in the Board of Trade building, with its Edison bi-polar 110 V. dynamos, switchboard, etc. The building was wired in brass-armored conduit.

## NEW INDUSTRY FOR HAMILTON.

The Ontario Lantern Company, of Hamilton, have recently added to their extensive manufactory a most modern plant for making incandescent lamps, and they have acquired the Canadian patents for the celebrated Shelby lamp, with double coil horizontal filament, and will manufacture the same in the varied sizes and efficiencies required.

They have associated with them Professor Chaillet, of Buffalo, one of the best electrical experts on this continent, and the lamps that are being made in Hamilton are likely to attain the high reputation enjoyed by the American Shelby Company.

The consumption of lamps is increasing rapidly throughout the Dominion, and we have no doubt that there will be a good demand for radiant Shelby lamps.

Mr. Walter Grose, of Montreal, is largely interested in this company, and is sole selling agent for the different lines of lamps, lanterns, etc., which they manufacture.

# TELEGRAPH and TELEPHONE

## CHAS. P. DWIGHT.

THE news of the death on January 20th of Mr. Chas. P. Dwight, assistant general manager of the Great North-Western Telegraph Company, came as a painful surprise to his many acquaintances and friends, the majority of whom were not aware of his illness, which lasted only five days. Mr. Dwight was attacked by a severe cold, which rapidly developed into acute pneumonia, to which, despite the efforts of the most skillful physicians, he succumbed.

Mr. Dwight was a native of Toronto, and was only twenty-nine years of age. He received his education at Upper Canada College, and Sorel College, Quebec. In 1891 he joined the Northwest Mounted Police, and served a year with that body. During this period he collected the material for a little book entitled "Life in The Northwest Mounted Police, and Other Sketches," which he prepared and published the following year,

THE LATE CHAS. P. DWIGHT.

and which evoked much favorable comment and had quite an extensive sale. He subsequently contributed cleverly written storiettes to various American publications, as well as to the press of his native city. In 1895 he prepared for the Canadian Electrical Association, of which he was a highly esteemed member, a carefully written historical paper on "The Telegraph in Canada." In 1892 Mr. Dwight entered the office of his father, Mr. H. P. Dwight, president and general manager of the G.N.W. Telegraph Company, where, by close application to his duties, combined with business ability of a high order, he earned advancement to the responsible position which he occupied when so suddenly called away.

The presence at the funeral of many employees of the company, and of floral designs from the various departments, evidenced the general esteem in which the deceased was held by his business associates, five of whom acted as pall-bearers, viz: Messrs. A. B. Smith, G. D. Perry, A. Cox, George Hogarth, W. B. Powell and W. J. Duckworth.

Mr. H. P. Dwight and his family have the sincere sympathy of their many friends in the great loss which they have sustained.

# ENGINEERING and MECHANICS

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Mr. A. M. Wickens, executive secretary of the Canadian Association of Stationary Engineers, reports that about two months ago a branch association was started at Sarnia, Ont., with thirty-four charter members, and prospects for a most successful association. Mr. Walter D. Hall is secretary.

The half-yearly returns from the various lodges are coming in promptly and show an increased membership. Vancouver No. 19 intend making a strong effort at the forthcoming session of the British Columbia Legislature to secure a license law.

Toronto No. 1 will hold their annual At Home in the Confederation Life Building on Thursday, February 14th. The committee are working earnestly to make it a success. At a recent meeting of the association a most interesting talk on electricity was given by Mr. E. J. Philip.

The executive secretary has received advice from Brantford that the engineers there are already preparing for the August convention.

## ARTIFICIAL FUEL.

Advices from abroad state that the British Admiralty is about to arrange for a series of trials of artificial fuel, the two varieties being Welsh bituminous coal residuum bound with pitch or tar, and the other a mixture of anthracite coal and highly bituminous matters with tar made up into blocks of 22 pounds each. A separate series of trials are to be made at different speeds, and with both natural draught and forced draught. There is a great disadvantage, however, in both kinds of fuel over ordinary anthracite coal, namely, that they produce intense volumes of black smoke. Ordinary anthracite is smokeless, but has the disadvantage that no one has hitherto been able to form it into briquettes. A process has, however, now been worked out at Swansea, England, for making anthracite briquettes with the admixture of bituminous coal and the like, and a plant is about to be put down for turning out half a million tons a year.

## STEAM – HIGH OR LOW PRESSURE?

When water is heated to the boiling point, the temperature remains stationary, and all subsequent additions of heat become latent, or unapparent, and are carried off in the form of steam. If a given weight of water be evaporated into steam in a perfectly steam tight boiler, says The Engineer, the weight of steam produced will be exactly the same as that of the water from which it was produced, that is, one pound of water will generate exactly one pound of steam.

One pound of water at a temperature of 212 degrees F., in passing into steam of the same temperature, absorbs as much heat as would have raised the temperature of the water 966 degrees, if it had not boiled and the heat become latent. Therefore, a unit of evaporation is the evaporation of one pound of water at a temperature of 212 degrees into steam of the same temperature, and is equal in round numbers to 966 thermal units. The heat required to raise one pound of water from zero to 212 degrees and evaporate it into steam of the same temperature is equal to 966 plus 212, or 1178 heat units. The quantity of heat required to evaporate a given quantity of water in a boiler depends upon the temperature of the feed water, for of course the more heat that is put into the feed water the less will be required in the boiler. If the temperature at which the water is supplied to the boiler be represented by t, then the total heat required to evaporate one pound of water from and at 212 degrees is, $1178 - t$. If the temperature of the feed water is sixty degrees, then the total heat per pound is $1178 - 60 = 1118$ heat units.

The quantity of heat required to generate steam increases slightly with the pressure, but the increment, or rate of increase, is so small that, for practical purposes, it may be assumed to be the same for all ordinary pressures. Hence the cost of fuel for generating steam is practically the same for high pressure steam as for low pressure steam.

The rate of evaporation, however, varies directly with the rate of combustion of fuel, that is, other things being equal, doubling the rate of fuel consumption doubles the rate of evaporation.

The total heat of steam increases with the temperature at the rate of .305 of a thermal unit for each degree of temperature above 212 degrees. The total heat of one pound of steam at 212 degrees is 1178 units measured from zero, and the total heat of steam at any other temperature may be found by adding .305 times the difference between the given temperature and 212, to 1178. The temperature of steam of 100 pounds pressure is 337.7 degrees, and the total heat of one pound is $1178 + (337.7 - 212) \times .305 = 1216$ heat units, or $1216 - 32 = 1184$ heat units, fractions omitted, above 32 degrees.

## ENGINEERING NOTES.

When starting up a new engine, the boiler pressure should be kept low and only a light load put on for a few days, until the parts that constitute the rubbing and revolving surfaces show no tendency to heat or cut.

Newly packed joints should be carefully watched, and as soon as they are thoroughly warmed up, and before pressure is put upon them, the nuts should be tightened again, as some kinds of packing become soft under the action of heat.

Visitors to your engine room do not stop to find out how much you are paid for running the engine that you have charge of, therefore do your work well even if you are not paid as much as you think the job is worth, for you will be judged according to your work and not by your pay.

When an engineer takes charge of an engine that he is not familiar with, he should not screw up the nuts on the piston-rod gland until he knows what kind of packing is in the box, for some metallic packings are wedge shaped, and the rod may easily be injured by screwing the nuts up too tight.

Drying Core Disks. When the disks are on and ready for drying the electrical mechanic must look after the air. It is not enough to have plenty of hot air to dry the core, for often it is found that, after all, the parts refuse to dry, even with a plentiful supply of hot air. This is due to the fact that the air has become saturated with moisture, and if this moist air is not given a chance to get out of the drying box, the parts will not dry. Therefore, one should see to it that the air has a chance to get out as well as in, and then there will be no trouble.

Mr. A. Reis, of Antwerp, has patented the following method for preventing incrustation in boilers: A mixture of sugar, tannin extract, silicate of potash or soda, and boric acid is added to the boiler water to keep the salts in solution. When the water attains a density of about 15 Be to 25 Be, the boiler is "blown off." The working periods range from a fortnight to three months, according to the quality of the water in use. Glycerine and alkaline sulphates are sometimes used in mixture. How much of the latter is required per gallon is not stated.

At the last meeting of the American Society of Mechanical Engineers, Chas. T. Porter, in his discussion of Dr. Thurston's paper on "The Steam Engine at the close of the Nineteenth Century," stated that it is a principle of the new engineering that "the boiler furnace shall be independent of natural draft, effectually consuming its smoke, and burning two or more times as much coal per square foot of grate as it could do under natural draft alone, and yet sending off the gases at a low temperature; the boiler being a steam generator, a superheater and fuel economizer combined." This statement clearly shows Mr. Porter's faith in the future of mechanical draft as a substitute for chimney draft as a means of securing the desired ends.

Oiling Machines.—It is worth while to take space to say a few words as to the oiling of those parts of the core shaft that are liable to heat. It should always be remembered that careful oiling means a saving of oil, but this is not the only benefit derived therefrom. The usual practice is for the operators of machines to oil up before starting, by taking an oil can on which the spout has been enlarged so as to emit a large quantity of oil quickly. The operator pours the oil on the several bearings, never noticing, apparently, that more oil runs off than remains. For every drop of effective oil used, probably 20 drops are wasted, and may be found in unsightly blotches on the side of the machines, as well as on the floor, making any operation necessary around these parts dirty and disagreeable work. A drop of oil put in the right place will do good work, but to do this it is necessary to repeat the operation oftener, and this is the reason why the oil is slapped on in large quantities, so as to last all day.

## STEAM TURBINES.

By James Ashe.

Inventors in our time seem to neglect the reaction principle in steam turbines. The first was Hero's edipile, which was invented about two thousand years ago and has been almost neglected ever since. Richard Trevithick constructed a turbine somewhat resembling Hero's early in the nineteenth century. It differed from Hero's edipile in this respect that it had no globe. Two hollow arms diametrically opposite each other received steam from a hollow shaft and discharged it at the edge of each blade near its outer end. Avery, of New York, constructed one somewhat similar to that of Trevithick about the middle of the last century. Mr. Charles H. Parsons also built one of similar construction to that of Trevithick. The hollow arms were of elliptical cross section and the steam issued through short tubes in a direction which was nearly tangential to the circumference of the circle, which was described by the outer ends of the rapidly rotating arms or blades. The turbine was shut up in a casing of cast iron, and the exhaust steam flowed into a condenser.

A speed of 5,000 revolutions was obtained from this turbine. The steam pressure was one hundred pounds on each square inch, and the steam exhausted into a condenser which had a vacuum of twenty-six inches. The turbine was tested and was found to yield twenty horse power, and to use forty pounds of steam for each useful hourly horse power. An aged British engineer told the writer that he had a turbine of Trevithick's type many years ago, and which he called a sword engine, because the forward edges of the blades were sharp that they might cleave the exhaust steam and thereby yield more power than could otherwise be produced. This aged engineer carried his turbine in his hand from place to place. He had it wrapped in paper like a parcel of goods. When asked what it was he said that it was an engine with which he meant to drive his saw mill. The hollow blades were about two feet long; the speed was about three thousand revolutions a minute. In regard to economy of steam this turbine was about equal to ordinary reciprocating engines of that time. The aged engineer stated that the only thing that could be said against the turbine or sword engine which he used was that in order to secure economy of steam it was absolutely necessary to employ steam of exceedingly high pressure. Consequently a strong boiler was required. This engine was made more than a generation ago, when boilers were not so capable of enduring high pressures as they are at the present time.

Why has the reaction turbine not been brought into extensive use? I have little doubt that an engine made exactly like Hero's, if supplied with steam of high pressure, would be as economical of steam as half the stationary engines which are now in use. I dare say that if one were constructed of say six feet in diameter or having blades of about three feet in length, discharging steam from the sides of the arms through holes of several inches in area, it could easily be made to yield more than three thousand horse power. Such a turbine would cost comparatively little and would occupy extremely little space. Should it be found that too great loss of power from churning the exhaust steam would occur, the turbine might be made in the shape of a wheel, discharging steam tangentially at the circumference. A casing allowing considerable space between itself and the turbine should in all cases be employed.

Dow's steam turbine has several rows of blades which are concentric to each other, and to as many rows of stationary guides. This is an outward flow turbine. There are equal numbers of rows of blades at the right and left of the entrance of the steam into the casing, consequently there is no end thrust on the shaft. This turbine has shown an economy of steam which is fair, considering the small size of the machine. It has been used in propelling the Howell torpedo.

Mr. C. H. Parsons' turbine is a compound wheel having a large number of blades, running between as many rows of guide blades, which are stationary. The blades or buckets of the wheel are larger and farther apart as the steam proceeds in order to give room for steam of diminished elasticity and consequently increased volume. There are blades on barrels of four different diameters, and there are many rows on each barrel. There are baffle pistons mounted on the shaft in order to counteract the end thrust on said shaft. In order to permit smooth motion, although the turbine may not be perfectly balanced, the journals run in several concentric sleeves supplied with oil under pressure. The governor permits the passage of the steam into the turbine in gusts. These gusts succeed each other more or less rapidly and endure for varying intervals according to the power required in order to maintain the proper motion of the turbine. This turbine contains an enormous number of pieces. For instance, one having a capacity of four hundred and two horse power has thirty-one thousand and seventy-three blades. Sixteen thousand and ninety-five of these blades are in motion, according to the statement of Mr. Francis Hodgkinson. A turbine of four hundred and two horse power, such as has just been described, yielded an electric hourly horse power with a consumption of steam which was only 16.4 pounds at full load. The same machine at one-quarter load used 22 pounds of steam for each hourly electric horse power. A Parsons' turbine of sixteen hundred and eight horse power developed the hourly electric horse power with fourteen pounds of steam. In Hartford, Conn., a Parsons' turbine of four thousand and twenty-one horse power is in course of erection. It will drive a generator for the electric light company. The wheel or runner weighs fourteen tons and is nearly twenty feet long. It is six feet in diameter at the widest part.

De Laval's steam turbine is a wheel having buckets round its circumference. A hoop is fastened on the periphery of the buckets. Steam is blown from several nozzles at an angle against the buckets on one side of the wheel, and the steam exhausts into a chamber on the other side. The wheel is mounted on a long thin shaft in order that the wheel may rotate about the proper axis when running at tremendous speed. This turbine has been used in driving centrifugal creamers and in driving dynamos. For driving these it is provided with fine gearing, because the speed would otherwise be too great for existing dynamos. The result of one trial showed that a De Laval turbine yielded three hundred and eight horse power with less than fourteen pounds of steam for each hourly actual horse power. The steam pressure was one hundred and ninety-two pounds to the square inch; the steam was superheated sixty-nine degrees Fahr., and the speed was seven hundred and seventy-two revolutions a minute.

In 1897 four groups of DeLaval turbines and generators of one hundred horse power each, and two groups of fifty horse power each, were in operation at the Stockholm Exhibition. Each group was entirely self-contained; boiler, turbine and dynamo all being set up on one base. The boilers were made of concentric coils of pipe of little more than an inch in diameter, consequently they were capable of sustaining enormous steam pressures. Steam was actually used in these boilers and turbines at a pressure of three thousand two hundred and thirty-four pounds on the square inch. Each pound of fuel in the furnace furnished from seven to eight pounds of steam. What the economy of the turbine proved to be has not been stated. The temperature of steam at three thousand two hundred and thirty-four pounds on the square inch is seven hundred and seven degrees Fahrenheit. In a theoretically perfect engine receiving steam at seven hundred and seven degrees, and exhausting it at two hundred and forty degrees, the efficiency according to the second law of thermo-dynamics would be $\frac{(707+459)-(240+459)}{707+459}$ or forty per cent. This is more than double the highest efficiency ever yet obtained by a reciprocating engine.

Of course, according to theory, it makes no difference what type of engine is used in order to obtain a given percentage of efficiency. But such high pressures as were used in the DeLaval turbine could scarcely be used in any reciprocating engine whatever.

Within the past year or two it has been shown by Professor R. H. Thurston that a very great increase in economy is obtained in DeLaval's turbine by superheating the steam before it enters the turbine.

It is certainly remarkable that steam turbines have been so little used. They have shown economy equal to the most economical reciprocating engines; they have no dead centres; the angular velocity is absolutely uniform at all points of the revolution. The turbine runs silently; it occupies very small space; it is not likely to get out of order; it can use enormous steam pressures because the hot steam meets neither oil nor packing. The cost is low and the attendant requires no special skill.

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Mr. W. T. Jennings, of Toronto, recently made surveys for a street car system in the town of Parry Sound, Ont.

The Electric Cab Company, Limited, of Toronto, has been incorporated, for the purpose of manufacturing and operating automobiles for general use.

Manchester, Robertson & Allison, Limited, have been incorporated in St. John, N. B., with a capital of $800,000, to supply electric light and power.

## SPARKS.

Messrs. Blanchard & Company, of Windsor, N.S., have installed a private electric light plant.

Mayor Hayward, of Victoria, B. C., is in favor of an extension of the city's electric light plant.

The town council of Almonte, Ont., have decided to engage an expert to value the electric light plant.

The light commissioners of Brockville, Ont., will take steps immediately to improve the electric light plant.

The annual meeting of the Lachine Rapids Hydraulic & Land Company will be held in Montreal on February 14th.

It is stated that a New York syndicate is about to develop the water power of the Pend d'Oreille river near Rossland, B. C.

The Mayor of Walkerton, Ont., has suggested that consideration be given to the question of establishing a municipal electric light plant.

A company is being formed at Bic, Que., to light that village by electricity. It is proposed to purchase the water power of Mr. Alf. Bouillon.

It has been suggested that the village council of Kamloops, B. C., should this year take up the question of improving the electric light plant.

The White Pass & Yukon Railway Company has recently added to its equipment at Skagway an electric light plant capable of supplying 800 lights.

Specifications ard being prepared on which to invite tenders for the electric lighting of the streets of Montreal upon the expiration of the present contract.

The Levis Electric Railway Company is seeking incorporation, to build an electric railway in that town and adjoining counties of Levis, Dorchester, and Bellechasse.

The British Columbia Electric Railway Company will this year make improvements to their plant at Victoria. The road bed will be improved and the system extended.

The Niagara District, Welland Port and Dunnville Electric Railway Company is seeking incorporation, to build an electric railway in the districts indicated by the name.

A suggestion has been made by the Mayor of Collingwood, Ont., that the services of an expert be engaged to report as to the required improvements to the electric light plant.

The town of Port Dover, Ont., is about to vote on a by-law to loan $10,000 to the Canadian Steam Carriage Company to establish a factory for the manufacture of steam automobiles.

Mr. J. W. McRae, late managing director of the Ottawa Electric Company, is taking steps to organize the Consumers' Electric Company, to supply electric light and power in Ottawa and vicinity.

The Niagara, St. Catharines & Toronto Railway Company have completed surveys for their westward extension towards Hamilton. The company also propose to build a spur line from Beamsville to St. Ann' s or Smithville.

The development of the water power of the Current river is now engaging the attention of the municipal authorities of Fort William, Ont., the proposition having met with the almost universal assent of the ratepayers.

The Citizen Electric Light Company has been formed at Leamington, Ont., and at a recent meeting Dr. Hughes, Messrs. J. A. McDonald, W. T. Easton and others were appointed a committee to proceed with the purchase of a plant.

At the annual meeting of the Niagara Falls, Wesley Park & Clifton Tramway Company, held on January 24th, officers were elected as follows: President, John W. Gilbert; vice president, Joseph A. Powers; treasurer, A. B. Colvin; secretary, F. C. McBurney.

At the annual meeting of the Winnipeg Street Railway Company held a fortnight ago, Mr. William Mackenzie was elected president, Mr. William Whyte vice-president; and Mr. F. Morton Morse secretary and treasurer. The old board of directors were re-elected.

Before the Peterborough Engineering Club recently, Mr. H. D. Burnett, of the Canadian General Electric Company, gave an interesting address on the "Nernst Lamp," showing by means of diagrams its construction and mechanism, and pointing out the field in which this form of lamp would find its usefulness.

The Maitland River Power Company has been organized, with Mr. James Clark as president. The company have in view the development of the power of the Maitland river near Goderich, and have made a proposition to that town to supply power sufficient to operate the waterworks and electric light plants.

A company is being formed in Montreal to establish an electric plant near Riviere des Prairies, to supply electric light and power in Sault au Recollet, Longue Pointe and other towns. The promoters include Messrs. Eugene Mony, civil engineer, and J. A. O. Laforest, former superintendent of the Montreal water department.

The stockholders of the Carillon & Grenville Railway Company, at their annual meeting in Montreal recently, discussed the question of using electric instead of steam power on their railways. It seems that a number of capitalists are considering the utilization, for electrical purposes, of the power at the old Carillon canal.

A special committee of the town council of Yarmouth, N. S., has been investigating the various methods of street lighting, and has recommended an electric plant using both enclosed arc lamps and 50 c. p. incandescent lamps. It is estimated that the cost for a plant to supply 31 arc lamps and 80 incandescents would not exceed $9,000.

The second annual meeting of the Renfrew Electric Light Company, of Renfrew, Ont., was held last month. A half yearly dividend at the rate of 6 per cent. was declared, and the following officers and directors elected : A.A. Wright, president ; A. H. Hough, vice-president ; H. Wright, secretary-treasurer ; Wm. Ringslenben and C. H. Wright (Toronto.) The new plant of the company is being installed.

At a recent meeting of shareholders of the General Engineering Company of Ontario, Limited, it was decided to change the name of the company to the Underfeed Stoker Company, Limited. The following gentlemen compose the new board of directors : President, Geo. Gooderham ; vice-presidents, John B. Laidlaw, D. Fasken, W. D. Matthews, J. L. Ross, J. D. Wright, Elias Rogers, H. M. Pellatt, T. G. Blackstock ; secretary, T. A. Rowan.

The annual meeting of the three electric railway lines controlled by the Cataract Power Company, of Hamilton,took place recently, when the following officers were elected: Hamilton Street Railway President, Hon. J. M. Gibson ; vice-president, John Dickenson, M.P.P. ; secretary, John Patterson ; treasurer, John Moodie. Hamilton Radial Company President, John Patterson ; vice-president, Hon. J. M. Gibson ; treasurer, John Moodie. Hamilton & Dundas Railway President, John Dickenson, M. P. P. ; vice-president, J. A. Kammerer, Toronto ; secretary, John Patterson ; treasurer, John Moodie.

## MOONLIGHT SCHEDULE FOR MARCH.

| Day of Month. | Light. | | Extinguish. | | No. of. Hours |
|---|---|---|---|---|---|
| | | H.M. | | H.M. | H.M. |
| 1.... | " | 2.30 | " | 5.45 | 3.15 |
| 2 .. | " | 3.15 | " | 5.45 | 2 30 |
| 3.... | " | 3.45 | " | 5 45 | 2.00 |
| 4. .. | No Light. | | No Light. | | . |
| 5.... | No Light. | | No Light. | | . |
| 6 ... | P.M. | 6.20 | P.M. | 9.00 | 2.40 |
| 7.... | " | 6.20 | " | 10.00 | 3.40 |
| 8. .. | " | 6.20 | " | 11.00 | 4.40 |
| 9.... | " | 6.20 | " | 11.45 | 5.25 |
| 10. .. | " | 6.30 | " | 0.30 | 6.00 |
| 11.... | " | 6.30 | A.M. | 1.30 | 7.00 |
| 12.... | " | 6.30 | " | 2.30 | 8.00 |
| 13.... | " | 6.30 | " | 3.30 | 9.00 |
| 14.... | " | 6.30 | " | 4.00 | 9.30 |
| 15.... | " | 6.30 | " | 4.45 | 10.15 |
| 16.... | " | 6.30 | " | 5.30 | 11.00 |
| 17 ... | " | 6.40 | " | 5.30 | 10.50 |
| 18.... | " | 6.40 | " | 5.30 | 10.50 |
| 19. . | " | 6.40 | " | 5.30 | 10.50 |
| 20.. . | " | 6.40 | " | 5.30 | 10.50 |
| 21.. . | " | 6.40 | " | 5.30 | 10.50 |
| 22.... | " | 6.40 | " | 5.30 | 10.50 |
| 23... | " | 6.40 | " | 5.15 | 10.35 |
| 24.... | " | 6.40 | " | 5.15 | 10.35 |
| 26.... | " | 11.00 | " | 5.15 | 6.15 |
| 27.... | " | 0.00 | " | 5.15 | 5.15 |
| 28.... | " | 0.30 | " | 5.15 | 4.45 |
| 29.... | A.M. | 1.00 | " | 5.15 | 4.00 |
| 30.... | " | 1.45 | " | 5.15 | 3.30 |
| 31 .. | " | 2.00 | " | 5.15 | 3.00 |

Total.........197.50.

## LARGEST INDUCTION MOTOR IN THE WORLD.

What is claimed to be the largest induction motor yet constructed has been installed by Brown, Boveri & Company, of Baden, Switzerland, in the waterworks station at Geneva. It is 1,000 horse power, and is directly coupled to a centrifugal pump. The motor weighs 27 tons, and runs at a speed of 544 revolutions per minute. The stator has ten poles, with six holes per phase per hole. The rotor has 180 holes, with two conductors to each hole, connected like a cylindrical drum armature with a three circuit wave winding. The motor is operated at 5,000 volts and an unusually high speed.

## WIRE FOR FUSES.

Following are the sizes of copper wire to use for fuses from 25 to 100 amperes :

| | |
|---|---|
| 25 amperes | No. 25 |
| 30 amperes | No. 24 |
| 35 amperes | No. 23 |
| 40 amperes | No. 22 |
| 50 amperes | No. 21 |
| 60 amperes | No. 20 |
| 70 amperes | No. 19 |
| 85 amperes | No. 18 |
| 100 amperes | No. 17 |

## LEGAL.

It is learned that the action brought by Mr. William Harris against the Toronto Electric Light Company has been withdrawn. Mr. Harris claimed $10,000 damages for the destruction by fire of his building on William street, Toronto, a year or two ago. He claimed that the fire was due to the contact of the Electric Light Company's wires with the building, and that the company had attached the wires to the building without his consent. The case was argued in the lower courts and an appeal taken, which appeal is said to have now been withdrawn.

## BRITISH ELECTRICAL WORKS.

We are in receipt of a brochure containing a description and excellent half-tone illustrations of the magnificent new works of the English Electrical Manufacturing Company, Limited, of Preston, Lancashire, England. These works, which were completed about six months ago, are unique in many respects, and their erection was the result of the immense quantity of electrical apparatus imported from Germany, America and other countries. Of the twelve acres of land embraced in the company's manufactories, about five acres are under roof. The buildings are laid out on the lines of the most recent American engineering works, the steel frame being first erected to carry the cranes and roof structure, and the sides and ends independently walled in. The machine shop, the largest building, is 900 feet in length by 120 feet wide, and the equipment is second to none. The English Electric Manufacturing Company is the pioneer undertaking of the kind in the United Kingdom, and is now prepared to carry out electric undertakings of all kinds, whether in lighting, locomotion, or electric transmission of power. The well known firm of Dick, Kerr & Company, 110 Canning street, London, E. C., are sole selling agents for the company.

## TRADE NOTES.

The Robb Engineering Co., Limited, have received an order from the Dominion Iron & Steel Co. for a 100 horse power Mumford standard boiler, this making the eleventh of this type shipped to the Steel Company.

The electrical business of Ahearn & Soper, Ottawa, has been incorporated into a joint stock company, under the name of Ahearn & Soper, Limited.

The Montreal Street Railway Company has placed an order with the Canadian General Electric Co. for a direct connected railway power generator of 850 k.w. capacity, or about 1,200 horse-power. It will be installed at the company's steam station, and will be directly conected to a cross compound engine.

Messrs. Kelley & Walker, of Vancouver, B. C., have received a contract from the Dominion Government to build a telegraph line from Golden through the Columbia valley.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

Vol. XI. MARCH, 1901 No 3.

## THE AUTOMOBILE INDUSTRY AND ITS DEVELOPMENT IN CANADA.

The progress that has been made in the few years since the horseless carriage was first recognized as a possible factor in transportation would seem to have met the expectations of the most sanguine, and shattered the predictions of the many who characterized the movement as a passing fancy. Originating in France, the horseless carriage agitation speedily spread to Germany, Belgium, England and other European countries, thence across the Atlantic to the United States and Canada. The introduction of the bicycle, with its pneumatic tire and ball bearings, seems to have brought to the attention of the people the possibilities and advantages of a carriage propelled by mechanical power.

That France is foremost in the development of the automobile industry is probably due in a large measure to the excellent roadways in that country. In 1898 it was estimated that the sum of $150,000,000 was invested in the automobile industry in France.

No. 1.—Electric "Victoria."—Canadian Motors, Limited.

In 1895 horseless carriages were exhibited at various fairs in England. They were invariably viewed with amazement by large crowds, as previous to that year very few had been seen on the streets. In the same year a contest was held in Chicago, when a prize of $5,000 was offered by the Times-Herald newspaper. At this event six vehicles started, the Duryea gasoline motor carriage being the winner, covering fifty-six miles, over bad roads, in less than eight hours. The vehicle weighed 1,208 pounds. This contest was no doubt of great benefit in assisting the expansion of the automobile industry and in finding a place for that class of vehicle amongst the needs of modern civilization. Previous to this demonstration, what the motor carriage could do on the ordinary class of roadway was regarded as very uncertain. In the intervening years since 1895 the automobile industry has been placed on a commercial basis, and to-day hundreds of machines are in use in the United States and Canada for transportation purposes.

The one feature upon which there is much difference of opinion, and which has demanded more hard, earnest study and investigation than any other branch of the business, is the motive power. From the first various kinds of power were employed—benzine, petroleum, compressed air, gasoline, steam, electricity, etc. Each had its advocates, and, according to the views of some, its drawbacks and defects. This struggle for supremacy in the motive power field still exists, with the balance of sentiment and number of vehicles in use in favor of gasoline, steam and electricity.

It is quite generally admitted that no type of vehicle will fully meet the requirements of all conditions for pleasure and business. Each type appears to have its field of usefulness, and development is likely to take place along the line of gasoline, steam and electric automobiles.

At the first annual exhibition of the Automobile Club of America, held in Madison Square Gardens in New York in November last, two vehicles attracted particular attention. One was a three-wheeled gasoline runabout, equipped with a four h.p., air cooled gasoline engine, regulated by a combination of variable compression and speed-changing gear. The other was an electric carriage for two persons which weighed only 550 pounds, and was equipped with a ¾ h. p. electric motor, chain-geared to the rear axle. A number of the small parts of this vehicle were made of a nickel-aluminum alloy, in order to reduce the weight as far as possible.

The cost of repairs is a point of considerable importance in motor vehicles. The Automobile, an American publication, recently secured statements from twenty owners of automobiles of various types showing actual results of 75,000 miles of road use. Five gasoline machines, reported with a mileage of 6,300, show repairs to have cost $470, or approximately seven cents a mile. Twelve steam vehicles, with a mileage of 26,500, show a repair bill of $1,532, or approximately five cents a mile. For four electric vehicles, with a mileage of 43,000, the expense of repairs was $420, or just a shade under one cent a mile. These figures, it will be seen, are strongly in favor of the electric carriage.

A question of some moment is how far an electric carriage will run without being recharged. In this connection it is of interest to note that an electrically propelled carriage carrying two persons made a trial trip from London, Eng., to Brighton, using one charge

of electricity only, the total distance covered, as shown by the cyclometer, being fifty-three miles. The run was made at an average speed of ten miles per hour.

THOUSAND-MILES AUTOMOBILE TRIALS.

That the gasoline motor has been developed in France and England to a much greater extent than any other type of motor is shown by the competition of motor cars which was inaugurated last year by the Automobile Club of Great Britain and Ireland. The distance to be covered was 1,050 miles. Of eighty-three vehicles entered for the trial sixty-five started, forty-nine of which succeeded in reaching the point of destination. All the vehicles, with four exceptions, were propelled by petroleum spirits. Several hundred miles of road were of the average good surface English roads, but there were at least two hundred of very bad surface and some steep hills. The grades included: 13,320 feet from 6 to 8 per cent.; 38,300 feet 6.5 per cent.; 7,338 feet 10 per cent.: 9,040 feet 9 per cent.; 10,500 feet 9 per cent. In the open country on good roads high speeds were occasionally made, some carriages reaching over forty miles per hour. With a steam carriage the average actual horse-power shown by the hill trial was 1.83, and the mechanical efficiency 0.61.

No. 2. Electric Delivery Wagon.

AUTOMOBILE PROGRESS IN CANADA.

The city of Toronto represents the centre of automobile progress in Canada. The first motor carriage to be built in this country was seen on the streets of Toronto in the fall of 1896. The motive power was electricity, the storage battery employed being the invention of Mr. W. J. Still, a local electrician. This carriage was owned by Mr. F. B. Featherstonhaugh, patent solicitor, and, somewhat modernized, is still in use. The battery consisted of twelve cells weighing 23¼ pounds each, giving a maximum of about 4 h.p. The cells were of the lead-lead pasted tyve, their average voltage being about 1.9 for the entire discharge. The motor was of the disc armature type, six polar, the field being series wound. When the battery was fully charged it was estimated that it was capable of propelling the carriage about sixty miles without recharging. The total weight of the vehicle was 750 pounds, of which 350 pounds represented the electrical equipment. The advent of this carriage was followed by the introduction of American carriages of various kinds.

The battery invented by Mr. Still was recognized as one of considerable merit, and a company was formed, known as the Still Motor Company, to manufacture electric vehicles of all kinds. In 1899 a factory was established at 710-724 Yonge street. The business was shortly afterwards purchased outright by British capitalists, who now conduct it under the name of Canadian Motors, Limited.

CANADIAN MOTORS, LIMITED.

The factory of the Canadian Motors, Limited, embodies every facility for the manufacture of electric carriages. Although the present premises are commodious, the business of the company is expanding to such an extent that it is proposed either to build an addition to their present building or secure larger premises elsewhere. The company have shipped a large number of carriages to Great Britain, where they seem to be meeting with general favor. In a recent international contest in London, England, held for the purpose of testing the speed and hill-climbing power of electric vehicles, thirteen racing machines competed. Canadian Motors, Limited, of Toronto, entered one of their ordinary road wagons which had been shipped to London some months previously, and according to the odometer on the wheel had run over 6,000 miles during the summer. The Canadian vehicle, we are told, carried four persons throughout the contest, while all the others, being racers, only carried two persons each. The first race was thirty miles over good roads, in which the Canadian vehicle came in second. The second race was thirty miles, taking in all the hill climbing, and in this the Canadian carriage came in first, with its double load of passengers, and had plenty of power to spare. The third race was the same distance over sand and heavy roads. The Canadian carriage was well in the lead at twenty-six miles, when it broke a ball in one of its bearings, which lost it the race. The carriage, however, finished the race, and, as in the other instance, had a surplus of power.

During the past six months this company have shipped over $20,000 worth of electric carriages to London, England, many of the leading persons there using them in preference to others. Besides the great demand for Canadian manufactured carriages in Europe, the Electric Cab Company, Limited, of Toronto, recently organized, have decided to use electric vehicles exclusively, and have placed a large order with Canadian Motors, Limited, for electric tally-ho coaches, victorias, broughams, landaus, oxfords, and light business runabouts, all of which are expected to be running on the streets of Toronto by the first of May.

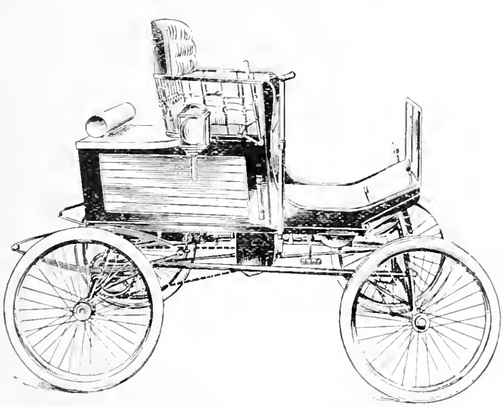
No. 3.—View of Gear of Electric Carriage, as Used by Canadian Motor's Limited.

The storage battery as now manufactured by and used in the carriages of the Canadian Motors, Limited, is claimed to offer many advantages over other makes

in the market. It is, as previously stated, the Still battery improved. Its simplicity and lightness of construction are said to make it an ideal battery for automobile purposes. One of these advantages is in the arrangement of the plates, which practically overcomes the washing action due to movement of the electrolyte in the cells during the operation of the vehicle. Another is the unlimited capacity for expansion and contraction which is claimed to overcome "buckling," while still another is the ability to charge and discharge rapidly without any deterioration of the plates. The battery for an ordinary carriage weighs about 500 pounds.

The peculiar feature of the motor is that the fields and armature both revolve in opposite directions, thereby reducing the speed one-half without gears, and also avoiding the use of differential gears. At the same time the lines of magnetic force are cut four times in one revolution, whereas in a stationary field the same number of lines are cut twice, the former method giving less work per revolution. The field magnet consists of soft steel rings to which the pole pieces are attached by means of bolts. On the end of the pole pieces are bolted phosphor bronze bells in which the armature ball bearings are placed. On these same bell ends are mounted insulated collector rings to which the wires from brushes and fields are attached. Collector dogs run on the rings, which are mounted on the case and are stationary. The whole motor is closed in a dust-proof case mounted on springs in a frame, which is fixed to the reach of the vehicle. The transmission gear is chain and sprocket ; one chain is coupled direct to sprocket on carriage wheel, the other is indirectly coupled, using an idler to get the same direction drive as the other wheel. There are three brakes, namely, foot, reverse and controller brakes. The speed may be increased or decreased, forward or backward, instantly by the simple movement of the lever.

The speed of the electric vehicle as manufactured by the Canadian Motors, Limited, varies according to re-



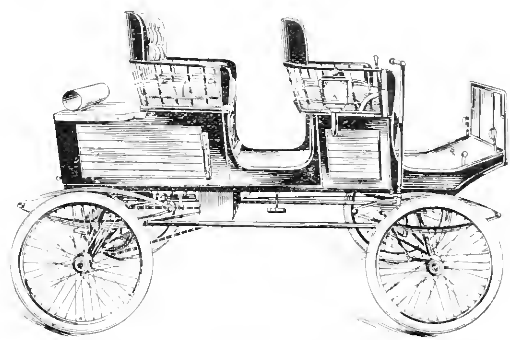
No. 4.—Single-Seated Steam Carriage.

quirements from three to seventeen miles an hour, although it is claimed that special vehicles can be built capable of running thirty miles an hour. A popular carriage manufactured by the company is the Victoria, of which a view is shown on the first page. This is recognized as one of their standard machines. The electric delivery wagon, shown on this page, is also a popular vehicle, as is also the Oxford. Figure 3 shows the gearing as used on their carriages.

The management of Canadian Motors, Limited, is in the hands of Mr. A. M. Thompson.

STEAM CARRIAGES.

The steam motor vehicle is also popular in Toronto. Some of them have been imported from the United States; others are from the works of the National Cycle & Automobile Company, whose head offices are at 34 King Street West, and who have given much attention to the



No. 5. Double-Seated Steam Carriage.

manufacture of the "Locomobile," as their steam carriage is designated. Although only engaged in this branch but a short time, the company are experiencing a very lively demand for their locomobiles. Almost every day they are in receipt of enquiries from intending purchasers in all sections of the Dominion. On the day that the writer visited their office, a letter enquiring about the steam carriage had just been received from Nova Scotia.

Three steam vehicles manufactured by this company are now employed by the post office department in Toronto. They are used for the transportation of mail matter from the Union Station to the post office, and for the collection of mail at the branch ffioces throughout the city. The accompanying view (Figure 6) shows the first automobile leaving the Union Station on July 3rd, 1900. The vehicles are equipped with a four horse power engine, the same size as is used in their one-seated runabouts. The boxes or bodies used for the post office vehicles are about three times as heavy as the body of the ordinary runabout. In addition to this weight, the post office authorities load the vehicle with from 400 to 900 pounds of mail at a time, and it is understood that so far this winter they have never missed a trip, and in nearly every instance have come in on time. It is learned from the post office authorities that the vehicles have given good satisfaction. It is the intention to send one of the vehicles to Ottawa, and in all probability the Post-master General will place orders for an additional number.

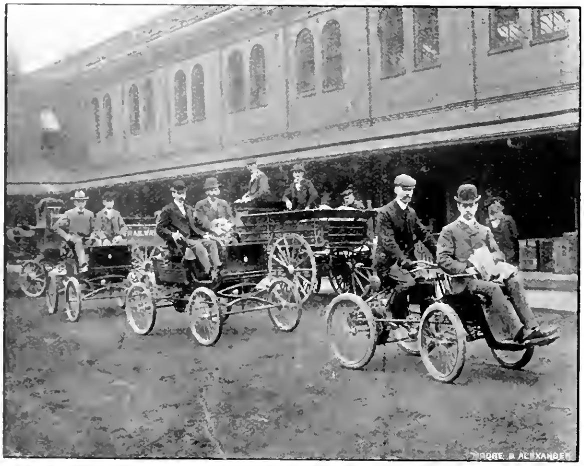
The method of construction and operation of the locomobile may not be generally known. The body contains the boiler, the engine, fuel tank and water tank. It rests on three springs, which are secured to a running gear composed of steel tubing. The water in the boiler is converted into steam by heat made from burning the vapor of ordinary gasoline, which is carried in a copper tank under the foot board. The gasoline is forced by compressed air through the boiler, where it is vaporized, and from there to the burner, where it is ignited. The compressed air is also stored in a copper tank. The operator sits on the right-hand side of the carriage, with his left hand on the steering lever. With the right hand the throttle lever is pushed forward

slowly. This admits steam to the cylinder and the carriage starts.

The steam is generated in an upright copper boiler. It is claimed that a running pressure of 150 pounds can be got in five minutes. Water is supplied to the boiler by a direct action pump connected to one of the cross heads of the engine. A by-pass lever gives the operator control of the water supply to the boiler, and a safety valve opens at 240 pounds pressure.

The engine is double acting, the reversing gear a simple link motion. With the exception of the eccentrics all bearings are ball bearings. The running gear consists of two steel-trussed ball bearing axles connected by a double reach; the whole is mounted on four pneumatic tired wheels. The front wheels are connected to their axles by swivel joints, and these are attached to the stearing gear, the lever of which controls the direction of the carriage.

The fire is controlled by an automatic valve which lowers the flame when the steam pressure reaches 180 pounds. A feature of the locomobile is the cross draught. This consists of a funnel placed at the back of the carriage and extending the full width of the carriage body.



INAUGURATION OF THE QUICK MAIL DELIVERY IN TORONTO.—THE FIRST AUTOMOBILE LEAVING THE UNION STATION, TUESDAY, 3RD JULY, 1900—TO DELIVER THE MAILS WHICH HAVE BEEN ALREADY SORTED ON THE TRAINS, TO THE BRANCH OFFICES THROUGHOUT THE CITY.

It is claimed that on average roads the locomobile can be operated from 40 to 75 miles with one tank of gasoline, and from 20 to 40 miles with one tank of water. The weight of the steam carriage ranges from 640 pounds to 1,000 pounds when empty, but when the tanks are filled the weight is increased by from 200 to 300 pounds. For a carriage weighing 640 pounds the capacity of the gasoline tank would be about five gallons and that of the water tank 21 gallons. The average price of the locomobile is between $1,000 and $1,200.

The National Cycle Company have effected an arrangement by which the fire may be lighted by a match instead of by a torch. They also equip their vehicles with non-freezing devices, and guarantee that the mechanism will not be affected by the cold water. Views are shown on previous page of their standard one-seated and two-seated vehicles.

GASOLINE VEHICLES.

The Duryea gasoline carriage, which was successful in winning the prize at Chicago in 1895, has been little heard of since that time. The Winton carriage has taken the lead both in Canada and the United States. The Canada Cycle & Motor Company, of Toronto, are sole Canadian representatives for this vehicle. This company also manufacture other types of gasoline carriages, as well as motor tricycles, trailers, quadricycles, and parcel carriages propelled by gasoline.

The first Winton carriage introduced into Canada was the property of Mr. John Moody, of Hamilton. It cost about $1,000, weighed 2,300 pounds, and carried two persons. Mr. E. J. Philip, of Toronto, also purchased a Winton carriage in the spring of 1899 The carriage is built by the Winton Carriage Company, of Cleveland, Ohio. The motive power is supplied by a horizontal gasoline engine. The firing of the mixture is done by eight cells of Nungesser battery. The feature of this carriage is the method of regulation. This is obtained by making the suction or admission valve stem very long, so that it extends through a head into a small cylinder. A piston is put on the stem in this cylinder, and between the little piston and head air is pumped by a small air pump worked from the engine. On the pipe between the pump and controlling cylinder are placed two valves, one a set valve, the other being controlled by the foot at will. In starting up there is no air pressure in the small cylinder and the valve can open wide, but as the engine speeds up air is pumped into the chamber, the valve is kept closed, and the engine will slacken down and run slower, just keeping the air supplied that is escaping at the set valve. The speed is controlled by means of clutches and can be regulated by raising or lowering the foot. A number of Winton carriages are now in use in different parts of Canada.

IN OTHER CITIES.

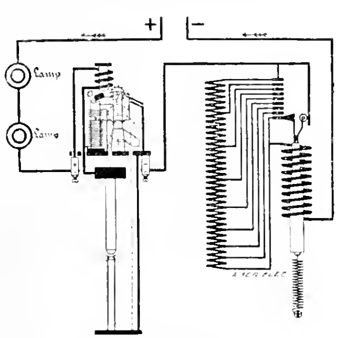
A number of automobiles of various kinds are to be seen on the streets of Hamilton, London, Ottawa, and other cities of the Dominion. In Montreal very few have as yet come into general use, owing to the steep grades. Mr. U. H. Dandurand is the owner of a steam carriage, and the National Cycle & Automobile Company have introduced their vehicles there. So far as can be learned, no carriages propelled by the storage battery by hydro-carbon are in service in Montreal. It is claimed that the hydro-carbon type, if not provided with a motor considerably larger than is necessary for usual requirements, will get "stalled" in hill climbing owing to the spark not "taking" at the proper time. It may be expected, however, that the automobile industry will be developed in Montreal as elsewhere. A company is now seeking incorporation under the name of The Montreal Automobile Company, to manufacture motor carriages. Mr. A. J. Corriveau is also interesting himself in the manufacture of such vehicles.

A company has been formed in Ottawa for the manufacture of locomobiles. It is announced that Mr. V. L. Emerson, of that city, is at work on what he claims will be the fastest and most powerful automobile ever built. It will be operated by a hydro-carbon motor.

## ARC LAMPS ON INCANDESCENT CIRCUITS.

When arc lamps are run on constant potential circuits, such as those used for incandescent lamps, it is always necessary to insert a dead resistance in series with them. The reason for this is that most arc lamps regulate by the action of a shunt coil, the potential at the terminals of which varies for different currents ; if it were not for the dead resistance this voltage would remain constant, as they are connected to constant potential mains ; the dead resistance is therefore necessary to produce a variation in the voltage with the current in order to bring about regulation. Many attempts have been made to do away with this resistance, as it wastes about 25 to 30 per cent. of the energy in a circuit in which two arc lamps are connected in a series across 110-volt mains. It seems now that this important problem has been solved practically by means of a differential arc lamp which has been in satisfactory use to a large extent for some months in Berlin. With these lamps practically no such dead resistance is required, and therefore the energy is more fully utilized, with the great advantage that three lamps instead of two may then be connected in series across 110-volt mains. As will be remembered, a differential lamp is one in which the regulation is effected by both a shunt and a series coil, and any variations in the current irrespective of those of voltage are then also used to operate the regulating apparatus.

A diagram of this lamp is shown in the adjoining illustration, in which three lamps are shown in series, of which one is represented with all the connections. It will be seen that the regulation is effected by both a series and a shunt coil and that there is, in addition, on the right, a dead resistance, which, however, is used only for starting, and is cut out by a movable core in the solenoid through which the main current passes ; the resistance is therefore only in circuit momentarily, to prevent the great current rushes. By using three such lamps in series instead of two of the ordinary form, the amount of light produced is increased in the ratio of




A Constant Potential Arc Lamp Regulator.

about three to four ; a room formerly requiring 12 lamps will then be equally well lit as far as the amount of light is concerned, by nine of the differential lamps, and, besides this, the amount of energy required will be less. When five or six lamps are connected across 220 volts instead of four, the increase of light is about 25 per cent. In that case it is better to use a dead resistance in each series, but merely for starting the lamps.—American Electrician.

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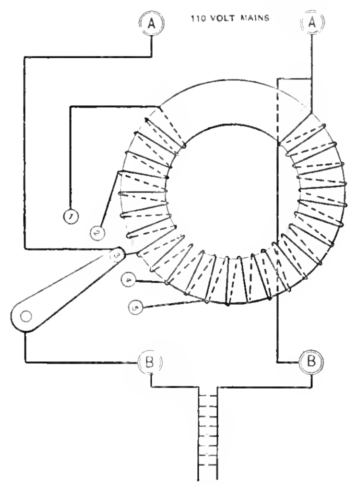
Mr. E. S. Harrison, of Winnipeg, has recently purchased a quantity of apparatus for his electrical testing laboratory.

## REMEDY FOR IRREGULAR VOLTAGE.

Mr. Thomas Barnard, of Toronto, sends to the American Electrician the accompanying sketch showing how to overcome irregular voltage, concerning which he says :

It often happens in small central stations that the voltage at the consumers' lamps is very different at different points of the distributing mains; consumers near the station will have a voltage higher than the




rated voltage of their lamps, and consumers remote from the station will suffer from low voltage. In alternating-current plants this irregularity can be easily remedied by installing a simple auto-transformer at the entrance of the low-pressure mains, connected up as shown by the accompanying sketch.

With the switch on button 3, as shown in the sketch, the e.m.f. of the mains will be applied to the terminals of the lamps; moving the switch lever to button 2 or 1 will increase the pressure at the lamps, and moving it to 4 and 5 will decrease the pressure. The one form of apparatus, therefore, is suitable either for places where the voltage is too high or places where it is too low.

The auto-transformer can be easily made by any central-station man. The core can be made up of sheet iron rings such as are used for armatures, and the winding can be calculated by means of the formulas recently given in your lessons department. It is not necessary, of course, to use the exact number of contact buttons shown in the sketch; a wider range of regulation can be obtained by increasing the number of taps. It is only necessary that that portion of the winding between the connections to the secondary of the transformer be calculated for the secondary e.m.f.

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## THE DODGE CALCULATOR.

We are in receipt of a very ingenious device called the "Dodge Calculator," issued by Dodge Manufacturing Co., of Toronto. The device is not only a novelty, but it is also an instrument of considerable value and assistance to all mechanics, foremen, superintendents, etc., whose duty it is to figure up speeds of pulleys, gears, etc. We are informed that the Calculator is one of the many uses to which the slide rule principle may be applied.

The Dodge Manufacturing Co. will be pleased to mail the Dodge Calculator free for the asking.

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The citizens of Thessalon, Ont., will be asked to vote on the question of installing an electric light plant.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING, Corner Yonge and Richmond Streets,

TORONTO, - - CANADA. Telephone 2362.

BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL. Bell Telephone 2299.

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***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics legitimately coming within the scope of this journal

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**Municipal Inconsistency.** IT does not appear to have dawned upon the city council of Toronto how absurd is their position in demanding the repeal of the Conmee Act, while proposing to take advantage of the act to expropriate the gas works.

**Canadian Electrical Association.** A MEETING of the Executive Committee of the Association to make preliminary arrangements for the annual convention in Ottawa was held at the Windsor hotel, Montreal, on Tuesday, February 12th. There was a full attendance. It was decided that the dates of the convention should be the 19th, 20th and 21st of June. A committee was appointed to arrange for papers and topics for discussion. A strong local committee was also nominated to make the necessary local arrangements for the meeting, which gives promise of being a most successful one. A number of new members were elected at this Executive meeting.

**Supplies for South Africa.** THE quantity of food and other supplies required by the British Government for the South African campaign is enormous. Many classes of supplies, such as canned goods, hay, cheese and bacon, flour and salt, portable houses, wagons, bicyles, axes, etc., Canada could supply, but the bulk of the orders seem to go to the United States. As an example the war office is said to have just contracted with a United States firm for 3,000 axes. We have given British manufacturers a preference in our market, and should have a claim to British orders for products which can be as well supplied by Canada as by the United States. If the British Government are ignorant of our ability to supply many of its requirements blame attaches to the Dominion Government, and no time should be lost in putting before the home authorities the fullest possible information regarding the character and extent of our resources.

**Financial Result of the Paris Exhibition.** THE footing up of accounts in connection with the Paris Exhibition indicates that if there be a deficit at all, it will be but a small one, while possibly there may prove to be a surplus—depending upon the willingness of the city to purchase certain improvements of a permanent character on the banks of the Seine. The cost of the buildings and other works was $18,000,000; the expenses of administration $1,700,000; policing, lighting, etc., $2,500,000; "unforseen expenses" nearly $10,000,000; miscellaneous expenses, $250,000, a total of $23,450,000. The receipts from all sources, including subscriptions of $4,000,000 each from the city of Paris and the Government of France amounted to $23,050,000, leaving a deficit of $400,000. This is a much better showing than was made by the French Exhibition of 1878, when the receipts fell short of the expenditure by six million dollars.

**Assessment Methods** IF the recommendation of the assessment commission that electric plants be assessed at their actual value be adopted great hardship will in many instances result. When installing these plants, whether for the supply of light power or street railway service, the owners in many cases deemed it advisable to make liberal provision in the way of surplus capacity for future require-

ments. We have in mind an electric street railway which having been built and equipped to provide for a growing traffic, is only now beginning to pay operating expenses, after having been operated for some years at a loss. In all such cases if the recommendation of the assessment commission should become a part of the assessment act, the owners of the plant will be out of pocket as at present the amount of interest on their non-productive surplus capacity, and in addition will be compelled to pay taxes thereon.

**The School of Practical Science.**

ATTENTION was called in these columns recently to the overcrowded condition of this school, and the urgent need for increased accommodation and equipment. During the present month this need has been forcibly impressed on the attention of the government by a petition presented by the students of the school. The prayer of this petition was strongly supported by deputations representing the Toronto Board of Trade, the Ontario Association of Architects, and the Canadian manufacturers' Association. Emphasis was laid on the necessity of providing adequate educational facilities for the large number of young men who are desirous of qualifying themselves to fill the more lucrative positions in the rapidly developing industrial enterprises of this country, which positions are at present too frequently occupied by graduates of foreign scientific schools. As an illustration of the present overcrowded condition at the School of Science, the fact was mentioned that the present first year class in chemistry, numbering 120 students, had to be divided five times. The Premier admitted that means must be found to increase the accommodation and efficiency of the school, and that at the present rate of expansion a new building would soon be the only remedy. The cost of a suitable building, together with the necessary additional equipment and teaching staff, was placed at about $300,000. The government should seriously consider what action should be taken and from what source the necessary funds could be obtained.

**A Dominion Exhibition.**

THE Dominion Government is said to have appropriated large sums of money to cover the cost of Canadian exhibits at the Glasgow and Pan-American Exhibitions. A large sum was spent for this object at Paris last year. We are not disposed to question the wisdom of these expenditures. It is good business policy to advertise to the world the character and extent of our capabilities and productions, thereby inducing increase of our population and investment of capital. Why should not this be supplemented by the holding of a Dominion Exhibition in Canada and the effort to induce foreigners to come and actually see for themselves the kind of country we have and the greatness of its resources? We cannot hope to carry out an exhibition on the scale of those held at Chicago and Paris, nor should the attempt be made. Our natural development has reached a stage, however, which should warrant us in entering on an undertaking of this character on a properly proportioned scale. The Dominion Government last year refused to assist such a project, perhaps because of the large expenditure that was felt necessary to secure adequate representation at the great international exhibitions at Paris, Glasgow and Buffalo. Next year when these shall have passed out of sight the subject of a Dominion exhibition should receive practical consideration, and the Federal and Provincial Governments which for many years have been spending money on Exhibitions got up by and largely for the benefit of other countries, should make a liberal appropriation towards a Canadian Exhibitionto be held in Canada, which the mother country, our sister colonies and our neighbors across the line should be invited to visit and send exhibits to. We have the nucleus of such an Exhibition at Toronto, and in connection with the proposal to erect new buildings the larger project should be kept in mind. It is doubtful if the property owners of the city whose approval must be obtained will sanction the proposed large expenditure for new buildings until just cause of complaint with the management of the Exhibition shall be remedied. If the project of holding a Dominion Exhibition in the near future is to be proceeded with it would be desirable to defer action with regard to new buildings in order that a comprehensive scheme adapted to the larger requirements might be formulated.

**The Commercial Position of Great Britain.**

FOLLOWING closely upon the announcement that Russia has increased its tariff on United States goods, comes a despatch from London that as an outcome of the inroads of American manufacturers upon British trade there is being formed the National Federation of Master Associations and Trades Unions to educate the minds of employees and employers in respect to the expansion of British trade, to devise means to meet foreign competition, to send joint deputations of capital and labor abroad to enquire into the conditions of other countries, and to provide a federation where employers and employees may meet on the same plane. This movement is under the leadership of Mr. John Lockie, late conservative member for Devonport, and is said to have the approval of the present British government.

The United States have not only become a strong competitor for foreign trade of Great Britain and other European nations, but have also invaded the British market, and are securing a large share of the home trade. It is stated that in one industry alone (the manufacture of boots and shoes) Great Britain's trade last year was less by $5,000,000 than in the preceding year, notwithstanding that the firms engaged in this industry are said to be among the most progressive and enterprising in the way of adopting improved machinery and other manufacturing facilities. The American manufacturer takes infinite pains to adapt his goods to the requirements of the particular market in which he seeks to sell, and by liberal advertising and persistent push keeps their merits before the notice of prospective buyers. In Great Britain there are many long established businesses which have descended from father to son. This has in many instances induced the idea that the system of management and character of goods that have been successful for so long a period may safely be continued. Rapid and startling changes are, however, taking place throughout the world, bringing changes in methods and requirements of the people. The nation that studies most carefully these changes, and constantly adapts its products to the new conditions, is the one which will obtain and maintain commercial supremacy. In this regard the United States seem to stand foremost to-day among the great commercial nations of the

earth, hence the strides they are making in the development of their foreign trade.

It is gratifying to note that Great Britain is awaking to the situation and considering ways and means whereby she may hold her commercial position. History has shown that the British people when once aroused are prompt to act for the protection of their interests whether territorial or commercial. Prompt, intelligent and thorough enquiry into the subject of Britain's commercial facilities and relations with other nations would seem to be a present and important necessity, and should be followed by equally prompt, intelligent and thorough reforms in methods, where such are found to be necessary.

The United States exports to Great Britain and Ireland are valued at \$600,000,000 per year, while the value of the imports from Great Britain into the United States is but 25 per cent. of that amount. The United States exports to Canada for the fiscal year ending June 30th, 1900, were valued at \$109,844,378, or more than the combined imports of France, Australasia, Austria-Hungary and Russia. While profiting so largely by British and Canadian trade, the United States continues to maintain a high tariff wall against these countries. The time seems to have arrived when freer access should be demanded by Great Britain and her colonies to the United States market, and in default of reciprocity of trade there should be a nearer approach than at present to reciprocity of tariffs.

Great Britain has in her colonies commercial allies which as yet she has scarcely taken any steps towards reaping the advantage of, but which, if brought into closer relations with her, would greatly assist in extending and maintaining her commercial supremacy. Canada has shown a desire to enter into such relationship by giving a substantial preference to British goods entering this market. That this action has not resulted in greater advantage to British manufacturers is largely due to the failure of the latter to make their goods better known in Canada, as well as to adapt the goods to our requirements.

Another phase of this question, as seen by an American writer, is presented in the following extract from the Engineering Magazine, of New York: "To the outside world the most impressive lesson of the Queen's death is the magnificent stability of British institutions and the British commercial system. Not a wheel stopped, save as a token of reverence; not a tremor in values disturbed financial centres; not an uneasiness or uncertainty as to national politics caused business undertakings to waver or hesitate. Compare this with the quadrennial upheaval in the United States, where economic legislation of every kind is the football of politics, and industry follows with uncertain feet now artificially raised on an unstable platform of protection, now sinking back from the morass of free silver, certain of nothing but uncertainty with every change of chief executive. The "demise of the Crown" demonstrates anew England's industrial strength, and those who are ready to cry her downfall before her industrial rivals would do well to remember that this stability of commercial organization outweighs much mechanical aptitude. Machinery can be bought, skilful brains and hands can be hired; but stable, political and commercial systems are of slow growth, and not soon attained."

## THE CHAMBLY POWER PLANT.

Extensive improvements are being made to the power plant of the Chambly Manufacturing Company at Chambly, on the Richelieu river, near Montreal. Immediately following the recent accident, Mr. J. G. Macklin, chief engineer, commenced operations to restore the working head and to provide for the reconstruction of the wrecked part of the waste gate section. A temporary timber cofferdam has been constructed on the upstream side of the break. It is composed of 16 x 42 foot cribs, 30 feet high, set 12 feet apart in the clear. They have walls of solid dovetailed timber, and were floated into position in a current of about 15 feet a second.

They were filled with rock ballast and sunk on the level rock bottom in about 12 feet of water, after which the 12 foot spaces between them were closed with stop logs. It is not expected that this cofferdam will be perfectly tight, and a second cofferdam will be built inside it to provide a dry excavation in which to build the new permanent dam. This dam will differ in its design from the first one, but its details have not yet been announced. It is of interest to note that originally only one-half of the tail race was excavated, and only to a depth to give 28 feet working head. It soon became evident that a great power development could be profitably utilized, and the second longitudinal half of the tail race was excavated for a head of 31 feet, and then the first half was unwatered and the bottom was excavated 3 feet deeper.

It is the intention, as previously stated, to rewind the present S.K.C. generators, which are at present wound for 12,000 volts, so as to make them work in parallel with new units which are being installed. These new units consist of four 2,000 kilowatts revolving field type, 2,000 volt alternating current generators, with the necessary water wheels and Lombard governors. The power house is being changed from a 12,000 volt direct transmission at two-phase to a step-up installation of 2,000 volts, using two phase on the generators and three phase on the line. This will also necessitate enlarging and re-arranging the sub-station in Montreal to receive the increased output.

The transformers, which will be of 2,750 kilowatts capacity, 3,600 horse-power output, are being built by the Westinghouse Electric & Manufacturing Company. Altogether there will be 20 transformers aggregating 72,000 horse-power. Ten are to accept a two-phase input at 2,200 volts and 8,000 alternations and give out three-phase current at 25,000 volts. The remaining ten are for lowering the three-phase line pressure received at 22,000 volts, delivering two-phase current at 2,400 or 4,800 volts, as required. Each transformer will be 9 feet high and weigh approximately 11 tons. All will be cooled by air from blowers driven by induction motors. The iron and copper have been proportioned to secure an efficiency of over 98 per cent. The Westinghouse process for the manufacture and treatment of the iron to render it capable of high magnetization with comparatively little energy and stable as resisting tendencies to show increased iron losses with service, will be employed. The phase transformation is to be obtained by means of special windings invented by Mr. C. F. Scott, of the company.

It is expected that the power house and dam at Ste. Therese will be completed this year, where it is hoped to develop 10,000 horse power under 16 feet head.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MARCH 16TH, 1901.

If the Smith's Falls correspondent who speaks of the fatal accident occurring with 110 volt circuit has an alternating current plant, it may be traced to a parallel instance which occurred not long ago in this city, where the transformer primary was in contact with the secondary and passed to 'ground' through the victim. If his plant is only 110 V. D.C., it seems almost impossible that such could cause death unless the victim was at the time in such a precarious condition of health as to be apt to drop dead at any time.

It seems hardly fair for college professors, who are no doubt well paid, to accept fees for consulting in engineering (electrical) work outside of their college. There are in the advertising pages of the ELECTRICAL NEWS, and also in the daily papers, cards of eminent electrical engineers who make a specialty of just such work, and it is practically "taking the bread out of their mouths." Colleges should realize that this in some cases injures their own old gradnates who have in addition to college tuition probably put in some hard practical work also.

In Ontario it appears to be coming quite the fashion for municipalities to appropriate the local electric light plant and run it as a civic or municipal plant. On account of the threatened combine of all the principal illuminating companies (including gas) here, some of our aldermen suggest that the city operate its own plant. Were it operated as economically (?) as some of the Ontario municipal plants, it might possibly reduce what is feared will be the combine's figure, but those who know Montreal's municipal record will greatly doubt this. The contract with the Royal Company, who do the street lighting, does not expire until next year, and it is as yet problematical to what extent the combine will attain and whether or no they will not reduce the figure at present ruling. It would be difficult to find many paying municipal plants in Canada, and Montreal would not be "in it." They have one in Glasgow, Scotland, but it is dangerous there for an official to hold his hand out behind his back, and the last alderman disqualified there met such a fate because he had procured a civic position for his nephew.

Of late there has been considerable complaint as to the quantity of salt used on the tracks of the Montreal Street Railway. The denial of their manager, Mr. Wanklyn, as to any surplus being used was further contested by one of their own shareholders, Mr. H. H. Lyman, in the daily press. The truth of the matter is that both parties are right, i.e., when Mr. Wanklyn or any of his officials are around the amount of salt used cannot be complained of, but when the artist with the long spouted can is left to himself he paces along at a slow march humming "en roulant ma boule," the salt meanwhile gushing forth "ad lib" to form, as it were, an accompaniment to the ditty. For the city, however, to resolve that salt, sand, and even sweepers shall not be used (as they once proposed) would be tantamount to saying "shout down." Some salt is absolutely necessary in Montreal; but judging by the character of the streets, were it not an exceedingly cheap article of commerce the lavish use of it would ere this have affected the dividends.

Toronto is evidently seeking for an opponent to the Bell Telephone Company, in spite of the warning they have had in the federal fiasco here, and in the exceedingly slow progress of present opposition exchange, the Merchant's Telephone Company, Montreal. This business, to be of service, must be a monopoly, and it remains for cities giving franchises to safeguard their interests, get commensurate percentages on income, etc. The Bell Company are adding instruments at an enormous rate here, and are extending by leaps and bounds, at the same time giving an excellent service compared to that in other cities. They certainly make hard and fast conditions in their contracts, but once signed the Bell Company seem to act up to their side of the question. The trouble complaints are promptly looked after, and the long distance service, though expensive, is excellent. On the whole, it is better to be this way than with a couple of mediocre 'phones in one's place of business, both companies cutting rates until neither can afford to give a decent service.

The Terminal Railway Company are seeking to extend their trolley system through Montreal streets. At present they run from Maissoneuve, our eastern suburb, down to Bout de l'isle (end of the island). Although they enjoy a large patronage in summer, it is a question whether their business in winter is a lucrative one, hence, probably, their desire to invade. Although it is not well in some cases to fight for a monopoly, yet in this case the majority of Montreal citizens will feel that they should not be put to the trouble of having more streets tracked simply to suit suburbanites when they have sufficient at present for their own ordinary requirements. McGill College would come under the influence of the current, throwing their delicate instruments out of calibration, and other prominent places voice their protests. Surely for a consideration the Terminal Company could arrange for running rights over the Montreal Street Railway Company's tracks. However, it looks at present as if the Terminal Company will eventually gain their point with our city council.

## THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

From the annual report of the directors of the Lachine Rapids Hydraulic and Land Company, of Montreal, presented at the annual meeting held last month, it is learned that the net profit for the year 1900 was $84,546.30. From this amount dividends were paid at the rate of 4 per cent. per annum for six months ending June 30th, and at the rate of 6 per cent. per annum for six months ending December 31st.

Many improvements were made during the year. The wing dam was raised above flood level for a distance of about 3,300 feet. The object of this was to do away with the overflow of the dam, thereby decreasing the current at the intake and saving the timber dam from being damaged by ice, and at the same time providing a deep channel in the tail-race for winter use and causing all the water used by the wheels to be discharged on the shore side. Among the improvements to the power house was the installation of new governors of improved type, with two additional governors for operating the exciter-wheels, also four new generators of 750 k.w. capacity at normal load. In the sub-station there were installed ten 250 k.w. air-blast transformers, complete with blowers, and a marble switchboard.

Property was purchased adjoining the sub-station on which to build a fire-proof transformer house during the coming spring, and it has also been decided to construct a duplicate pole line to the Rapids.

There were purchased during the year meters costing a total of $7,641.57, making the total number of meters in use at close of the year 2317. The net increase of equivalent 16 c. p. incandescant lamps added to their circuits during the year amounted to 15,376, making a total of 71,500 lamps connected, in addition to 205 arc lamps on flat rate. The power in motors connected to circuits during the year amounted to 1,548 h.p. In this estimate is not included some 1,300 horse power which is being supplied to another company for emergency purposes.

## THE PETERBORO WORKS OF THE CANADIAN GENERAL ELECTRIC COMPANY.

During the past year extensive additions and improvements to the Peterboro works of the Canadian General Electric Company have been made. The new building erected includes the business offices and an immense modern manufacturing shop. The office building is two stories, commodious and well equipped, and finished in natural oak. The lighting of the office is by arc lamps of a handsome pattern.

The new factory is a modern manufacturing building, with gallery, the entire height of the interior being unbroken save for a spacious gallery about 25 feet wide that skirts the entire interior at a height of 15 to 20 feet from the main floor. The factory is 280 feet long and 100 feet in width. It is of brick and steel, the massive steel pillars and the strong steel girders forming one complete frame, in nowise dependent upon the masonry, but capable of standing quite separately from such. Running the entire length of the building is a crane track supported by steel pillars, upon which is operated a forty ton crane. By a system of fire protection the entire roof sheeting can be instantly soaked with water by means of small pipes projecting beneath the roof at right angles from larger conduits. In the western wall of the addition has been constructed three furnaces, or kilns, which are intended to abstract all moisture from armatures or coils. It is proposed to have the armature, testing and transforming departments occupy the ground floor of the new building, while the tool and brass departments will probably be installed in the gallery.

## QUESTIONS AND ANSWERS

"Superintendent" writes: We have some cars on our road equipped with K2 controllers, and I would be glad of any directions you can give me for keeping them in good shape. What is the best way to stop the use of the shunt on the last step, which is a faster speed than we need? Shall I open-circuit the wires leading to it?

ANS.—The first essential for the care of these controllers is the same as for any other electrical appartus, viz., keep them absolutely clean; have the tension springs adjusted so that the fingers press on the cylinder hard enough to prevent all chances of arcing, yet not too tightly, or else they will cut. A very little lubricant may be occasionally rubbed on the various contacts of the main cylinder, though none is necessary on the reversing fingers. All lumps caused by any unusual arcs must be filed off and the fingers of the main cylinder adjusted so that wherever two or more of them make contact on the same step, they all touch simultaneously. This will divide the arc among all the fingers so that each takes its proper share, otherwise one finger may be opening the circuit in front of the others on the same step or position, which results in badly burning the insulating arc deflectors placed between them and perhaps in a short circuit between fingers or a ground to the case. The best way to open the shunt circuit is to take off the shunt contact pieces on the parallel side of the cylinder; you will find them held by a single screw each, they are the two pieces which raise the shunt fingers when the controller is put on the last step. You can, of course, cut the wires which lead to the shunts, or take off the shunt fingers, but either of these two latter methods will cut the shunt out on the series as well as the parallel position, and thus give a somewhat more jerky acceleration of your car than would otherwise be obtained.

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"L.G.H.," Newmarket, Ont.: I am thinking of putting in electrical power in my printing office to be supplied by the Street Railway Co., and I wish you would give me your opinion on the following questions:

(a) Do you consider power from the Street Railway would be satisfactory? I want to use power for Monoline typesetter, which is calculated to run with 1/6 of a horse power. This machine is supposed to run 8 hours per day, and I could attach a small press to the same shafting. The other machinery could easily be run by a 3 horse power motor. In fact, I run everything now with a 3 horse power gasoline engine all at once.

(b) What should I pay for current per year to run a 1/2 horse power motor for the Monoline typesetter and a small press, and do you think that the fluctuation in the current would cause any trouble?

(c) Would you advise me to put in 4 horse power motor to supply power for all the machinery, since I don't use the full power only about 6 hours per week?

(d) Would the fluctuation of the current have any effect on the life of the motor? I hear that one man in North Toronto tried power from the Metropolitan Railway, and he was troubled with the fuse burning out every little while when the power went down. He was using a 6 horse power motor. Do you suppose that would be the case if I used a 4 horse power motor? Do you know of any office using current from a street railway plant?

ANS.—(a) It depends entirely upon the voltage regulation obtaining on the particular road you have in mind. The pressure on street railway circuits, especially those of small roads, varies considerably, producing a corresponding variation in the speed of the motors connected to it, and it is a question which can be decided by no one but yourself, as to whether the speed variation caused by this is permissible in your work or not.

(b) About $30 to $50 per horse power year of 10 hours per day, 6 days per week.

(c) No; keep the size of the motor down as much as possible consistent with safety, that is, if 3 horse power will drive all your machinery, when everything is running simultaneously, and you use this amount for only 6 hours per week, which we presume means an average of one hour per day, we would think that a 2 or 2½ horse power motor, if of a good type, would be quite sufficient for your needs.

(d) Variations in the voltage should not injuriously affect the motor unless it rose to an extremely high point, say 600 or 625 volts for a 500 volt machine. If you use the proper kind of starting rheostat you should experience absolutely no trouble beyond the speed variation due to the fluctuations in the voltage. The size of the motor would not make any difference. We do not call to mind off-hand any printing offices operated off street railway circuits, though of course there are numbers of stationary motors operating various kinds of machinery supplied by current from this source.

We presume you have looked into the question of insurance, the underwriters usually objecting to any wires connected to a grounded circuit such as a trolley line being taken inside of or even on to buildings on which they are carrying a risk.

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"Dynamo Tender" writes: I am operating a generator which was sold to me as a 500 lighter, which I figure ought to give 20 lights to the ampere, while I am only able to get 15 lights to the ampere. How could we find out the capacity of the machine? For some weeks past I have not been able to get the machine to pick up the current promptly at the start. I have gone over all my connections, tested my machine for a ground. There is a single pole exciter, but no brushes on the machine. When the current starts she will run all night without a spark.

ANS.—There are several points which would affect the case in question. One is the voltage at which the machine would be operated; of course, the higher the voltage in the lamps the more lamps of 16 c.p. you will get to the ampere. The results also would depend very much upon the efficiency of the lamps. Supposing the current is transformed in a ratio of ten to one, the voltage of the machine being 1,100 and the efficiency of the lamp 3.5 watts per candle, this would give 19 lamps per ampere of the primary current. This would be the theroretical result without considering loss in line and transformers. Without further information on these points or a test of the dynamo it will be impossible to say just what its capacity is.

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"Subscriber": I have several long burning arc lamps on 110 volt D.C. current, and I have been having trouble with one of them. It will burn 10 or 15 minutes, then blow the fuse. It cannot be a short circuit or it would

blow the fuse at once, would it not? It has been burning all right until just lately. What do you think the trouble is?

Ans.—Your trouble may be due to a variety of causes, and it is extremely difficult to say just what part of the lamp is out of adjustment; possibly the clutch is slipping and not picking up the carbon promptly enough, or the coil may be partially short circuited, as also may be the case with the resistance. Have you examined the fuse and its holder thoroughly; any bad connection round it would tend to materially lessen its carrying capacity and make it blow at a current much below the normal. If you find nothing wrong after going over everthing carefully, we would feel inclined to try a larger fuse. Lamps of this character, burning normally with about 5 amperes, require usually from 15 to 20 ampere fuses.

"R. T." writes: I am thinking of putting up a transmission line for my factory here, and would like your opinion as to whether it is advisable to put up a barbed wire as a lightning arrester.

Ans.—At one time it was thought that barbed wire made a good arrester and that its use was almost a necessity on any long lines, but the experience of the last few years has tended to very much reduce its use, it having been found to be the source of much trouble from rbeaks and the consequent short circuiting or grounding of the main wires. It undoubtedly is a good arrester when properly put up, but no matter how well the work is done, it is found that breaks will occur very frequently, entailing numerous shut-downs, and the latest modern practice seems to favor the use of the ordinary arrester installed at frequent intervals along the line.

"H. L.," Montreal, writes: I understand that some roads are using the Canadian General Electric Company's K10 controller for 4 motors, but have always understood that it was built for two motors only, and would be glad of any information you can give me.

Ans.—The K10 controller is rated by its manufacturers as capable of controlling two 35 horse power 500 volt railway motors, or as having approximately a capacity of 150 amperes at 500 volts. Now, if the combined capacity of the 4 motors does not appreciably exceed the above controller rating, no difficulties from abnormal arcing or excessive heating need be anticipated, but owing to the reversing switch being provided with contacts for but two motors, it becomes necessary to group the 4 motors into 2 groups, each consisting of two motors with their field coils permanently in parallel, and also their armatures, instead of having the wiring of each motor completely separate from that of the others. This method of connecting generally results in the work and current being very unevenly divided among the motors, and consequently in a great increase in motor troubles and the repair bills therefor, and is not, to say the least, a practice to be recommended.

Mr. Manuel, of Burford, Ont., contemplates putting in an electric plant.

Montreal capitalists, under the name of the Trinidad Electric Company, have obtained control of tbe existing tramway lines and ligbting plant in Port of Spain, Trinidad, and are about to convert tbe tramway to an electric system and extend the lighting plant. Those interested included Messrs. W. B. Chapman, A. F. Gault, F. Wanklyn and others of Montreal, and B. F. Pearson and David McKean, of Halifax.

# CORRESPONDENCE.

## THE DESIGN OF TURBINES.

QUEBEC, March 1st, 1901.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR, Your short editorial upon the above subject in last month's issue of THE CANADIAN ELECTRICAL NEWS opens up a question of great moment. The development of water powers in our country can scarcely be said to have begun, in the way of the development of high heads particularly, and your timely suggestion that this class of hydraulic work should be studied by Canadian manufacturers, is appreciated in not a few localities.

The designing of turbines in the United States and Canada has not been carried on in the same way as say steam engine work, for broadly speaking, there is as much difference between the methods of designing engines and turbines as there is between day and night. In the first case, designing has been along the line of results afforded by means of well developed experiments. In the other case, it has been purely empirical, perhaps not even that in the vast majority of cases; it could be better expressed by the term "cut and try method," or the vigorous application of the drawknife, a little off here and a little off there, and another amaturish test made of the turbine, that in its local sphere of manufacture can lick anything on earth, and give the Dutchman's percentage.

Most American turbines have been developed by unscientific mechanics, and any advance made has been due solely to the advantages afforded by Holyoke testing flume. An unfortunate feature about Canadian made wheels is the unwillingness of manufacturers to submit their work to test, not simply placing their wheels in the same flume with one of foreign make, and because they may both be styled the same number of inches in diameter; and further, if the home manufactured wheel develops more power than the foreign made one, a great noise is made about same, and yet no one has any knowledge of the venting powers or the co-efficiencies of efficiency of either the one or the other.

The diameters of turbines as catalogued to-day is a misnomer. Take one and all of the catalogues published and figure out the co-efficiency of speed, and the variation will be from 65 per cent. to 90 per cent. and upwards that of the theoretical starting velocity of the head under which they are tabled. Why is this? In engine work you can design for any given piston speed. And yet turbine builders do not know for a surety what speed they will obtain should they change the discharging angle of the buckets; that can only be obtained by test.

Until we come at the methods of designing turbines known to continental hydraulic engineers, it is not much use of Canadian builders attempting to build for high heads and guarantee an efficiency approaching 80 per cent. Constructing turbines for high heads of say over 50 feet is an entirely different matter to that of supplying wheels for medium heads of say 10 to 25 feet. Now, most turbine builders believe that they have secrets about their wheels both as regards the design and manufacture that they keep to themselves because of a supposed pull it gives them to secure contracts over the heads of their competitors in the business. Now, take it all in all, the diversities of gate arrangements, the various forms of buckets, with flaring discharges, corrugated receiving edges, projections upon the faces of the buckets, inward discharge, outward discharge, downward discharge, and all other known ways of discharging water through a turbine; if they were one and all taken as wheat is taken to winnow the chaff from same, some good ideas might be obtained which would be of use to the turbine designer, not the man who with drawknife may form a turbine bucket, but to the one who over the drafting board designs turbines, and who is supposed to have more than an elementary acquaintance with the torricelliam theorem or any hydraulic formulae, then we might hope to be able to build bome made turbines unequalled anywhere. I look for that time. I believe that Canada has the greatest water powers on earth, and there is no question that the time is close at hand when Canadian manufacturers will be able to produce the article. I have only written in a general way, perhaps not affording even a good thought to the subject, but I have done so solely because of my interest in the subject and to thank you for calling attention to the matter.

Yours truly,

"TURBANUS."

The Glen Tay Power Company, of Perth, Ont., has been organized with Hon. J. G. Haggart as one of the directors.

# ENGINEERING and MECHANICS

## CHIMNEYS AND STACKS FOR STEAM BOILERS.

By W. H. Wakeman, in Modern Machinery.

The statement that a chimney or stack is necessary to create draft under a steam boiler, except where forced draft is used, will occasion no surprise, because it is a self-evident truth. But all of the necessary appliances are not equally efficient, and in some cases the cause for the deficiency may be easily traced out, while in others it requires careful investigation in order to locate the trouble.

The theory of the cause for draft in a chimney is well known, but no other theory in relation to engineering is more persistently doubted, by the "practical" man, and there are not sufficient causes to warrant this continued opposition. I have never met a man who doubted the theory and could substitute a better one for it; the large majority of unbelievers do not attempt it.

This theory is as follows: Currents of air vary in density, consequently the more dense parts seek the lowest level, while the lighter parts rise as high as possible. As the lighter parts rise the heavier parts are drawn in to take their place, and if this process takes place in a chimney, and the only entrance to the base of it is through the furnace of a steam boiler, a draft will be created, the force of which will depend upon the comparative density of the air, and gases inside and outside of the chimney, and for convenience sake this force is measured in inches of water.

From this it is evident that the lighter the gases are in the chimney the stronger will be the draft, so that while a high temperature of escaping gases denotes that much of the heat in the coal burned has not been absorbed by the boiler, and hence is at least a partial loss, the draft is increased over what it would be with a lower temperature; therefore, more power can be developed by the plant.

In many cases chimneys do not give as much draft as they were expected to, and are therefore considered detrimental to the economical combustion of the coal burned, and are condemned by the engineers in charge. The objects sought in writing this article, are to point out some of the causes that are responsible for this undesirable state of affairs, in order that the blunders made may be rectified in the best way, while others may profit by the suggestions here offered and avoid future failures along this line; also, to show that the problems of chimney design are not as complicated as certain mysterious formulas used in this connection, in works on the subject, would naturally cause us to believe.

In many cases the surrounding objects will determine the necessary height of chimney, for it would be a mistake to erect a chimney 100 feet high near a building that stands 125 feet above the ground, as the draft would be poor.

For the purpose of illustrating the rules to be given and explained, I shall assume that the chimney is to be 144 feet high, the temperature of the air 60° Fah. and of the gases 500° Fah.

The draft will be determined by the difference in the density of the air and the gases, and by the height of the chimney. The density will vary as the absolute temperatures, and for the air it may be determined by dividing the absolute temperature of melting ice by the absolute temperature of the air, and multiplying quotient by .0807. As the absolute temperature of a body or of gas is 461° more than its temperature by the thermometer, it is 32 + 461 = 493° for melting ice. The absolute temperature of the air is 60 + 461 = 521°.

Then 492 ÷ 521 × .0807 = .0763.

The density of the gases is found by dividing the absolute temperature of melting ice by the absolute temperature of the gases, and multiplying the quotient by .084. Then 493 ÷ 961 × .084 = .0430.

Using the foregoing data we can determine the draft in inches of water by subtracting the density of the gases from the density of the air, and multiplying the remainder by .192 and again by the height of chimney in feet. Then .0763 — .0430 × (.192 × 144) = .92 inches of water.

I have given this example because it explains the process, but where no explanation is desired the following rule may be used, as it gives nearly the same result. Divide 7.66 by the absolute temperature of the gases and subtract the quotient from .0146. Multiply the remainder by the height of chimney in feet. In this case it is 7.66 ÷ 961 = .00797, and .0146 − .00797 × 144 = .95 inches of water.

For the same temperature, the draft for any other height may be found by proportion, as it varies with the height. For a chimney 200 feet high it is as follows: 144 : .92 : : 200 1.27 inches of water.

Disappointment is the result of expecting that the actual draft will equal this, as it will not; and yet the calculation so far given is correct, but no allowance has been made for the friction of the gases as they pass upward through the rough and sooty chimney or stack, and for ordinary cases; 10% should be deducted for this, which leaves .93 inches of water for the first illustration given.

Where we need the draft at the grate where the fuel is burned, and between this and the chimney, the passageway contains several obstructions in the form of a contraction at the bridge wall, where tubular boilers are used, a return bend in the combustion chamber, a division of the current when passing through the tubes, a right angle turn at the front end of the boiler and another one when the nearly horizontal flue is reached, and perhaps one or two more before the chimney is reached. About 25% reduction must be made for these, leaving an available draft of .93 − (.83 × .25) = .63 inches of water, and where several boilers are connected to the same chimney, it may be expected that some of them will realize more of the draft than others. These rules for chimney draft are based on the assumption that the gases maintain a uniform temperature throughout their ascent through the shaft, but this is not true in practice, for as they travel farther away from the boiler, the temperature is reduced, thus bringing the density of them nearer that of the outer air. This will detract from their drawing power, and still it must be remembered that as the temperature is lowered, the volume is reduced, so that one tends to offset the other.

As already mentioned, some men dispute this theory, and, as evidence in their favor, point to the fact that a chimney will draw when there is no fire to heat the air in it. This is not strange, for in many cases it is heated by natural means, which answer every purpose. If the sun shines on an iron or steel stack, the internal air is warmed more than the outer, and draft is created. Even when the sun does not shine on it, the inside of the shaft is not exposed to the wind, hence it may be much warmer that the wind that blows against the outside of it.

Draft does not exist in all chimneys when cold, for I have had to build a fire at the base of the shaft, or in the breechen of the boiler, on several occasions in order to make the chimney carry off the smoke of a fire on the grate.

It is not a difficult matter to measure the draft of various chimneys, and note the results, taking their height and other conditions into consideration, when it will be found that sometimes a high chimney will give no more draft than a lower one does in another locality, but in all such cases there is some reason for the results; although it may not appear on the surface. A few years ago much was written concerning the great advantage of having a chimney flue larger at the top than at the bottom, and apparently very good reasons were given for the plan, but where one built in this way did give good results, we were never sure that some other condition was not responsible for the desirable condition of affairs.

I never knew of but one case where a stack that was larger at the top than at the bottom was taken down and reversed. This was of much interest, because it was set up again in the same locality, and the same boilers were used. After the change, there was not enough difference to be perceptible in every day service, but a carefully graduated draft gage showed a slight improvement with the small end of stack uppermost. As already observed, the ascending gases become cooler, and hence are reduced in volume, and therefore there is no logical reason for the top being the largest.

It is important that we know the amount of coal that it is possible to burn in one hour on each square foot of grate surface, and for making this calculation Prof. Thurston gives the following rule: Multiply the square root of the height by two and subtract one from the product. In this case it is 23 pounds.

Now I have no doubt that this rule is correct, for it is based on the results of experiments made, and it can be, and is done in every day practice, but it results in a lower efficiency than can be

secured by a slower rate of of combustion, and where this rule is applied to lower chimneys with feebler draft, in order to burn the coal it calls for, it becomes necessary to "break the fire up" at short intervals, where bituminous coal is used, and every time this is done some of the good material is lost through the grates, and there is no help for it. When anthracite coal is used, the fires must be cleaned often, which results in a direct loss.

If a mechanical engineer should design a plant with the expectation of burning this amount of coal for ordinary service, it would be a great mistake. I would reduce it by 40 , making it 13.8 pounds, as that is the most that should ever be burned, and when the load is lighter (as it varies in almost every plant), the amount would be less. Still, this would admit of an increase for short periods without serious detriment. It is proper to make the area of a chimney large enough to burn the maximum amount of coal that can be used on the grate, and then it can easily dispose of the smoke and gases resulting from any smaller quantity. This makes it necessary to know the number of square feet of grate surface, and for illustration it is assumed that there are three boilers, each having 30 square feet of grate surface. We then have 90 square feet, and 23 pounds for each, or 2,070 pounds per hour as the maximum quantity that can be burned.

The area of chimney in square feet is found by dividing the pounds of coal burned per hour by the square root of the height, multiplied by 12. In this case it is $2{,}070 \div 144 = 14.4$ square feet.

The diameter of a round flue that will contain this area is found by dividing by .7854 and extracting the square root of the quotient; $14.4 \div .7854 = 18.5$, the square root of which is 4.3 feet. If a square flue is wanted, it should not be less than four feet, because the corners are of little value, for the friction of the gases as they ascend in these parts is excessive, hence they may be ignored in a case like this. The horse-power of boilers that may be operated by this chimney can be determined by dividing the coal burned by 5, and $2070 \div 5 = 414$ horse-power.

The allowance of five pounds of coal for a horse-power may be considered excessive, but it is customary to make this allowance, in order to be on the safe side. Automatic engines require less than this as a rule, but pumps require much more.

If it is desired to calculate the required area of flue by the horse power of chimney, it may be done on the same basis, by dividing the horse power by .2 of the height. Applying it here shows that the area is $414 \div (.2 \cdot 144) = 14.4$ square feet. It is much better, however, to calculate directly on the amount of coal burned.

I am convinced that some reader will look over these calculations, and then find one or more chimneys that are not as large as they call for, so that a text will be afforded for another sermon on the difference between theory and practice, but I will make such investigations unnecessary by saying that I know of such cases right in the vicinity of where this is written, but they prove nothing against theory. If it could be proved that the best results are secured where such monstrosities are in use, then theory would have to be discounted, but as this is not done it will have to stand approved. I will mention the essential features of a case with which I am well acquainted. The horizontal flue leading from a battery of boilers to a chimney is of the right size to suit the capacity of the steam generators, but the chimney area is only a trifle more than one-third of the flue area. This plant is run nearly every working day in the year, but an investigation of the practical results, and an interview with the engineer in charge, would convince the most skeptical that there is chance for much improvement.

In another case the brick chimney of a small plant did not give satisfaction and the owner put an iron cap on the top of it in which was a hole smaller than the conditions called for, and over this was erected an iron stack, which showed that the designer believed in having it high enough, but cared nothing for the area.

A certain class of objectors claim that it is not necessary to have a strong draft because the damper regulator is shut for a portion of the time, so it is just as well to have less draft, and let the damper be open for a greater portion of the time. This is a mistaken idea, for the fire should burn briskly while the draft is on, and when the required steam pressure is secured, it should be shut off until the pressure is slightly reduced. A good damper regulator will attend to this duty in a perfect manner. The philosophy of this is that while the draft is strong the combustion is more complete than when it is feeble. Another reason is that under these conditions much of the soot is swept through the tubes, instead of being left in them; consequently the boiler gives better results from the fuel burned under it.

In some cases it may be convenient to know the power of a certain chimney to burn coal, as for instance where an old chimney is to be used for a new plant of boilers, or where a new chimney of a given size may be desired. This may be determined by multiplying the area in square feet by 12 and the product by the square root of the height. Suppose that a chimney is 120 feet high with a round flue five feet in diameter. The area is 19.6 square feet, and the square root of height is 11. Then $19.6 \cdot 12 \quad 11 = 2587$ pounds per hour.

According to a rule already explained, a chimney 120 feet high will burn 21 pounds of coal per hour on each square foot of grate. By dividing the total weight burned, by the latter, we find that the chimney will furnish draft for $2587 : 21 = 123$ square feet of grate, and for four boilers it will be 31 square feet for each.

I have noticed that in several cases where chimneys have not given satisfaction, they have been built higher in order to increase their capacity. This is good practice, but I wish to call attention to the fact that while the force of the draft increases directly as the height is increased, its capacity for burning coal increases only as the square root of the height. This is an important point, for if it is not understood, disappointment may result, where an addition is built on to a chimney. If a chimney 80 feet high does not give sufficient draft, and it is possible to build it 80 feet higher, the force or intensity of the draft should be very nearly doubled.

To conclude that it will be possible to burn double that amount of coal with it, would be a great mistake. Each pound of coal requires a certain amount of air for its combustion, and the amount passing into the furnace of a boiler will, of course, depend upon the rate at which it travels. Now the intensity of the draft denotes the pressure that is forcing air into the ash pit and up through the grates, but if this force is multiplied by two, the speed will be increased as the square root of two, which is 1.44. It follows as a natural consequence that if it is necessary to double the amount of coal burned, the height of chimneys must be multiplied by four, and if great exactness is desired, enough more must be added to overcome the friction of the increased length of shaft.

A few years ago, if I had been called upon to decide whether to use a brick chimney or an iron stack, I should have favored the brick structure without hesitation, because iron stacks were proving failures after a few years of service, while bricks and mortar were not ruined by the different kinds of gases traveling upward, and were affected little by the rain travelling downward, while a coat of paint every year or two was not necessary.

Conditions are somewhat different now, for steel has replaced iron, proving much more durable, while improved methods have made it possible to erect these stacks and keep them in place during heavy gales without guys of any kind, so that as far as present experience will warrant an opinion, the two kinds are about on a par.

Before closing this article I wish to correct a mistaken idea that is often expressed by thoughtless people concerning the cause of a poor draft on some days where it is usually very good. Whenever the smoke curls lazily out of the chimney, and then seems inclined to come down to the ground instead of going into clouds, the remark is made that the draft is poor because the air is "heavy." If this is disputed, attention is called to the fact that the smoke comes downward, as truth of the proof of it.

The foregoing calculations concerning chimney draft were made with the assumption that the barometer stood at a certain given point and that the density of the air would correspond. If the barometer shows that the air is indeed heavier than the standard taken, the difference between the density of the air and of the gases will be greater, hence the draft will be stronger and not weaker. On the other hand, if the barometer shows the air to be lighter, the comparative density will be less, and as a natural consequence the draft may be less, in direct contradiction to the popular expression.

## ENGINEERS' AT-HOME.

The At-Home of Toronto No. 1, C. A. S. E., which was held in the Confederation Life Building on the evening of February 14th, was characterized by the same large measure of success which is common to similar events of this association. The large hall was appropriately decorated. Mr. James Huggett presided at an excellent musicale, at which the contributors were Miss Coutts and Messrs. Maguire, Gillogly, Smith and others, Miss McKay being the accompanist. Dancing followed, and was apparently thoroughly enjoyed. A splendid supper was furnished by Caterer Jacques. The committee in charge of the entertainment comprised Messrs. C. Moseley, president, J. W. Marr, secretary, A. J. Butcher, A. M. Wickens, E. J. Philip, Jas. Bannam, G. C. Mooring, N. Kuhlman, S. Thompson.

# ELECTRIC RAILWAY DEPARTMENT.

## MR. DUNCAN McDONALD.

Many persons identified with street railway matters will recognize in the accompanying portrait the features of Mr. Duncan McDonald, late superintendent for the Montreal Street Railway Company, who recently went to Paris, France, to become general manager of the Compagnie Generale de Traction. Mr. McDonald had been connected with the Montreal Street Railway for over twenty years, and is well known to the street railway fraternity. Before leaving Montreal he was tendered a banquet by the officials of the company and presented with an illuminated address and a well filled purse by the employees under his superintendence.

Mr. McDonald states that in France electricity as a motive power is yet in its infancy. A number of electric lines have been constructed in Paris, but so far few of them have been operated; they use what is known as the diatto compact system.

Mr. McDonald will have associated with him in his new field Mr. Nelson Grayburn, formerly electrical engineer for the Montreal Street Railway Company, but latterly superintendent of rolling stock with the Corporation Tramways, of Glasgow, Scotland. These gentlemen will no doubt introduce vast improvements to the street railway system of the French capital.

MR. DUNCAN McDONALD.

## THE ELECTRIC STREET RAILWAY OF GEORGETOWN, DEMERARA.

To Canadian capitalists is due the credit of having provided modern electric street railway systems for the cities of Kingston, Jamaica, and Georgetown, Demerara. The prime mover in these undertakings was Mr. W. B. Chapman, of Montreal. In a recent issue of the Street Railway Review some interesting particulars are given by Messrs. N. Swan and N. S. Rankin regarding the construction of the system at Georgetown, British Guiana, a city with a population of 60,000.

In the summer of 1899 Mr. Chapman was successful in securing the necessary franchise, which was immediately financed by a Canadian Company, with Sir William Van Horne at its head. The Georgetown Tramway Company and the British Guiana Electric and Power Company were purchased and united under the style of the Demerara Electric Company, Limited. Amongst its officers are Sir William Van Horne, B. F. Pearson, of Halifax, and W. B. Chapman and Ernest Alexander, of Montreal, the last-named gentleman being secretary of the company.

The construction of the road was carried out under the superintendence of the late Frank P. Btothers, who was manager of construction for the Kingston, Jamaica, electric road. Many difficulties of construction were encountered, such as the intense heat and glare of the sun, the slow and uncertain arrival of goods, and heavy tropical rains and storms. At one time during the construction there was not one period of twenty-four hours passed in ninety-two days that some time rain did not fall; and before resuming work after a cessation of rain it was necessary to bale the water out of the trenches which had already been cut and prepared for receiving the rails.

Nearly everything for construction purposes had to be imported into the colony, and the failure of contractors to ship materials on specified dates greatly hampered the rapidity of construction.

The system consists of 10.2 miles of track. A 62-lb. steel T rail was used, with girder rails at curves and switches. Both straight track and special work were supplied from the United States. The rails are set on concrete stringers 22 in. wide by 10 in. deep, with steel ties 10 ft. apart.

The overhead construction is single No. 0 copper, with Heckla bronze insulation as supplied by the Albert & J. M. Anderson Co. Iron tubular poles set in concrete support the feeder and trolley wires, and as the company controls both the private and public lighting of the city, these wires are also being transferred to the iron poles, and the old wooden ones removed. Both bracket and span wire is used in different portions of the city. Mr. J. W. Morris, of St John, N.B., who has had a large experience in Canadian and American cities, as well as in the tropics, had entire control of this branch of the work.

The company commenced to operate with 14 open cars made by the St. Louis Car Company. These are 8-bench cars with reversible seats, monitor top and bonnets, end bulkheads with glazed sash and double thick glass, revolving signs, etc. They are handsomely painted and decorated, and are fitted with Providence fenders. The electrical equipment consists of a Westinghouse No. 12A, 30 h. p., 500-volt, slow-speed single motor, with G. E. controller R-17. As there is hardly a grade in the whole city, cars should be operated at a very small cost.

The existing car sheds, with alterations and additions, have been transformed into first-rate car barns. In accordance with the style of building most in vogue in the tropics, they are open, and have a capacity of 16 cars. Four tracks run into the shed, which has also pits and machine shop. There is additional space for three other tracks when required. A part of this building is devoted to storerooms. Outside are three tracks on which cars can be run on emergency, or stored there at will.

The power station, which has been built for some years and was originally the property of the British Guiana Electric Light & Power Co., has been thoroughly overhauled and reconstructed by the present company, which has also put in two additional engines and generators for railway work and the supplying of power. The franchise of the company gives it the exclusive right to make and supply electricity for the term of thirty years,

with renewal features which make it practically perpetual. The original station comprised a duplicate plant for lighting purposes, consisting of two vertical and three horozontal engines giving a power supply of about 800 h. p. These have batteries of Babock & Wilcox and Stirling boilers, which are also in duplicate, and suffice to supply steam for the two new engines installed.

These new engines were supplied by the Robb Engineering Company, of Amherst, N. S., and comprise one 200 h. p. direct-connected, tandem-compound engine and one 200 h. p. belt-connected, tandem-compound engine. The two latter engines and generators suffice also to form a duplicate plant for railway purposes. It is the intention of the company later on to extend the lines into the suburban districts, which are thickly populated and give promise of good traffic.

## THE NELSON ELECTRIC RAILWAY.

Within the past year the Nelson Electric Tramway Company, an English company organized by Mr. W. H. Drummond, obtained a charter from the city of Nelson, B. C., to operate an electric railway. Up to the present about three miles of road have been completed, but we are told by the Journal of Electricity that it will probably be extended to some of the suburban mining camps. There are three cars, each equipped with four G. E. 1000 motors, controllers and brakes. The grades are very heavy, maximum 17 per cent., and the cars, especially on Sunday, are generally heavily loaded. After considering the question of motive power, the company finally concluded to give the West Kootenay Power and Light Company, of Rossland, the contract for supplying 500 horse power, to be transmitted electrically from the generating station at Bonnington Falls, on the Kootenay River, a distance of 12 miles from Nelson.

The West Kootenay Power and Light Company's sub-station in Nelson closely resembles the one in Rossland, as does also the Nelson pole line, but the latter was not roofed as was the Rossland transmission pole line. The two lines are of No. 8 B. & S. hard-drawn wire, and supported throughout on porcelain triple petticoat insulators of Redland's type. The lines pass through the end of the sub-station, where the usual equipment of choke coils and lightning arresters is placed, to a high-tension switch-board consisting of two blue Vermont marble panels, each mounted with a double-throw, quick-break switch, and containing the usual facilities to afford safety and celerity in the handling of both the lines and banks of transformers. For instance, both lines can be fed into the same transformer, or, to make still better regulation, one bank of transformers can be fed from one line for the railway load, leaving the other line and bank of transformers for the lighting load. The latter are of the usual air-blast type. The primaries take either 9,600 or 16,000 volts, according to whether connected in delta or in star, while the secondaries deliver 2,200 volts.

The three-phase current at 2,200 volts is led direct through the low-tension switchboard to a Canadian General Electric revolving field 350-kilowatt synchronous motor, the designation of which is "A. T. 18, 350, 400, 2200, and which is directly connected to a 325 kilowatt direct current generator on the same base. The designation of the latter is "M. P. 6, 325, 400, 550." This generator furnishes direct current to the railway. The switchboard at present is a three-panel one. The railway generator panel is of the customary type, with a large Weston station voltmeter swung to the side, and is provided with a magnetic blow-out circuit-breaker at the top of the panel.

The synchronous motor panel is similar to the machine panels at the main plant, being equipped with a Thomson alternating voltmeter and three ammeters, oil-break switch, "I. T. E." circuit-breaker and field rheostat.

The thiid panel is one on which is mounted a synchronizing device, exciter ammeter, field rheostat, and a special switch for the 30-horse power starting motor, which is located on the base of the motor generator, set and connected by a gear and clutch to the main shaft. This starting device has proved very successful.

All track through the city is laid with 72-lb. T rails on cedar ties. The rail joints are bounded with 000 rail bonds, and cross-bonded at frequent intervals. All poles are of cedar, overhead construction being supported by G. E. apparatus. The trolley wire is No. 0, fed at frequent intervals from a No. 00 feeder.

## ELECTRIC RAILWAY ADVANCEMENT.

One of the most interesting phases of the almost phenomenal increase of electric street railway mileage in this country, has been the corresponding increase in the amount of riding solely for pleasure, or as it might be called, the artificial traffic. Not over two or three years ago it was an open question, says the Street Railway Review, whether street railway companies could profitably invest money in parks and amusement attractions, whereas to-day there is hardly a road in the land that does not own, or at least is interested in a park resort of some kind. In a number of cities, as at Brooklyn, Cleveland, Toronto, and others, this feature has developed to such proportions that it is found advantageous to appoint a separate official, known as the outing or excursion manager, to relieve the general manager of the details of caring for and encouraging pleasure riding. This is a point worthy of consideration. The right man giving his entire time to this one department should have no difficulty in increasing the receipts of the road by a sufficient amount to considerably more than pay the extra expenses, including his own salary.

## THE NIAGARA, ST. CATHARINES AND TORONTO ELECTRIC RAILWAY.

The Niagara, St. Catharines & Toronto Railway Company are building an electric railway on the Canadian side of the Niagara river, to work in conjunction with the International Traction Company. The company purchased the franchise of the Niagara Central Railway Company between Niagara Falls and St. Catharines, as well as the Niagara Falls road between that town and Niagara Falls South. It is also proposed to build a line to Hamilton, and possibly to Toronto.

The line between Niagara Falls and St. Catharines is now being operated. Six cars, each fifty feet long, divided into smoking, baggage and passenger compartments, are in operation. These cars are said to contain more glass than any other car ever constructed ; the windows are large, and all the petitions are of glass. It is reported that a speed of seventy miles an hour can be maintained on the line. The stockholders in the company include Messrs. Robt. Jaffray and S. H. Blake, of Toronto, H. H. Herbert, of New York, and Addison B. Colvin, of Glen Falls, N. Y.

# TELEGRAPH and TELEPHONE

## AN HOUR WITH THE HELLO GIRL.

Number.

Busy.

Hello !

It is a busy hour, and the Central Telephone Office of the city of Toronto is eyes front, with mouth close to the receiver. I see few faces, but scores of bunches of back hair—golden, brown, or black—all artistically arranged ; a strange subdued sound of many voices ; a murmuring as of the wind whispering in the trees, making music with the leaves.

Here is where a great city is doing much of its business.

What tales of love have been whispered through this room ; what of future happiness ! What meetings have been arranged through this room ; what tender messages ; what grim messages ; what hurried calls ! What of natural ; what of supernatural ; what of life, of death —what has it not heard, this murmuring room ? What its secrets !

But its voice is close, as close as the grave.

Tell me some of your hidden mysteries. They would make sudden proof that truth is stranger than fiction.

You refuse !

Perhaps well so. You carry the great unknown of Toronto in these wires in these receivers, in the coils upon coils of wire, in the great jars in the basement below.

And you—Electricity—you, the all-powerful genius, who presides over it all ; you who, yet invisible, work as I watch ; you even now are quietly and mysteriously bringing thousands together in a twinkling. You hear a number called, and laugh at space. Will you tell your secret ?

You, too, refuse !

Before me are the long-distance girls. I bend over ; one is whispering :

"Hello, Chicago !"

And Chicago whispers back : "Hello, Toronto !"

Thus a modern miracle is performed.

A husband in Montreal is telling his wife in Bloor street :

"I'll be home on Saturday morning." And she sends him a kiss in a jeff. He receives it in the ear.

Another miracle. And yet the world takes it all as a matter of course.

Little red lights flit above the girls, sometimes glowing like fireflies, then again dying into darkness. The guide explains that when a girl leaves a call unanswered the light burns, but when her connections are made the light dies out.

"Hello !"

"Number ?"

"Busy !"

"Yes, it is busy."

"Oh ! you did not ring."

"No, you didn't call me."

"Don't ring so hard. I heard you."

"Drop 5 cents in and push the button."

And so it ran in ceaseless rhythm.

The enquiry office consisted of two wise looking girls, whom the public of Toronto daily deluge with questions, who carry thousands of facts, figures, and numbers in their heads, on their fingers' end ; who are the Solomons, the Daniel Websters, of the room and their world.

We went down to No. 1000, the "trouble department." As I went in a man said :

"Who are you ?"

I started to tell him, but he was talking to a fellow in the West End, who was registering a kick.

Toronto's Central Telephone Office is a great sight in a busy hour.

Charlie Churner, in The Star.

## METHOD OF RAISING AND REPAIRING A CABLE.

Some time ago the Great Northwestern Telegraph Company's cable between Kingston and Wolfe Island failed. Recently Mr. A. B. Smith, superintendent of construction, undertook to raise the cable for the purpose of locating the defect. This cable was laid about 35 years ago. It is steel armoured and is about 9,000 feet in length. Owing to its stiffness, the usual method of raising and coiling on the deck of a steamer could not be followed. The plan adoped was to raise the end of the cable at Kingston and fasten it securely on shore. Then the raised portion was thrown across the bow, along the side of the deck, and over the stern of a wrecking tug, the bow of which faced the shore. The tug was then slowly backed up along the route of the cable, the cable being thus gradually raised and carefully examined along its entire length. About midway the cable was cut and the remaining portion tested, but without locating the defect. The portions were spliced together again, and about 1,000 feet from the opposite shore the cable was again cut and tested, but the defect could not be located. It was afterwards discovered, however, in the portion of the cable lying in a trench on the land. It was found that the cable had been flattened and the insulation badly damaged. This has now been repaired, and the cable will be again available for use when required as a part of the system of communication between Canada and New York state.

## THE BELL TELEPHONE COMPANY.

Some interesting particulars of the growth of the Bell Telephone Company's system in Canada are contained in the annual report presented at the annual meeting held in Montreal on February 28th, at which the president of the company, Mr. C. F. Sise, presided. The company owns and operates 343 exchanges and 494 agencies. The total number of instruments now earning rental is 38,360. There were added during the year 3,437 subscribers. Mr. Sise, in referring to the pubic's use of the telephone, said that from carefully prepared reports covering all parts of the Dominion it was found that each instrument was used on an average of nine times each day. The average period elapsing between the time the subscriber rang the central until he had the desired communication was eleven seconds.

The long distance lines now owned and operated by the company comprise 21,350 miles of wire on 6,525 miles of poles ; 2,430 miles of wire were added to the system during last year. The receipts for the year were $1,614,262.88 ; expenditures, $1,229,977.56, leaving net revenue $384,285.32, from which $371,304.-99 was paid in dividends. The balance, $12,980.33, added to the balance from 1899 of $190,123.38, totals $203,103.71. Of this $32,898.64 was carried to in-

surance reserve, making it $100,000. There was carried to contingent account $46,119.20, and written off plant and patents $50,000, leaving $74,085.87 carried forward to 1901; $190,000 of 5 per cent. bonds were sold during the year, the net premium on which was $18,775, and 500 shares of stock were also sold at a net premium of $35,105.80. These premiums, aggregating $53,880, have been carried to contingent account, which with the addition from revenues now amounts to $900,000. During the year the plant and patent account was increased by $858,578.94, and, less $50,000 written off, it now stands at $6,053,015.27. The entire capital stock having now been issued, and funds for construction being required, the shareholders at a special meeting held December 5, 1900, authorized application to parliament for power to increase the capital from $5,000,000 to $10,000,000, and the petition will be presented in due course. At the same meeting the directors were anthorized to issue $2,550,000 of bonds.

## METHOD OF PRESERVING POLES.

In setting telegraph and telephone poles the earth should be removed a few inches from the poles and at a depth of two or three inches, and this hole should then be filled with tar oil, so that the pole is tarred just above and below the ground. After this is done the earth should be placed back. In some localities the Bell Telephone and Western Union companies, using large round poles, dig narrow channels from two to three feet deep around the poles and fill the channels with rock salt for surface preservation.

## TELEPHONY IN GREAT BRITAIN.

The National Telephone Company, profiting by the experience of the telephone system in America, particularly in San Francisco, intends to extend its operations in Great Britain in a way that will bring the benefits of telephone communication within the reach of a much wider circle than at present. The company is prepared to fit up and maintain telephonic instruments on subscribers' premises on the party-line system. The cost of service is collected at the time by an ingenious arrangement on the penny-in-the-slot system, hence there is no account to meet monthly or quarterly, as the case may be, and all liability is confined to the following rates: Two dollars and 50 cents a month for each subscriber on a two-party line, $2 on a four-party line, and $1.25 on an eight-party arrangement. Under this last head the total cost works out at $15 per annum.

Owing to the many complaints made by subscribers of the delays in getting connection with places in the country, the National Telephone Company has communicated with the postoffice in hope of remedy. The response, however, is to the effect that a minimum of 20 minutes must always elapse before any reply can be made as to when a call for a telephone district outside the metropolis will be answered. It is believed that an insufficiency of trunk lines and a lack of employees are responsible for this new and vexatious regulation, which is certainly not a hopeful augury for the coming postoffice telephone system.

The shareholders of the Sackville Electric Light Company, of Sackville, N. B., have decided to enlarge the plant. A brick building will be erected, and a new boiler and engine installed.

## PERSONAL.

Mr. Walter White, son of Hon. A. J. White, of Halifax, N. S., has been appointed manager of the Sydney Electric Light Company, of Sydney, C. B.

Richard Shopland, late in the employ of the London Electric Company, has accepted the position of chief engineer of the Sandwich, Windsor & Amherstburg Street Railway.

Mr. James Milne, who has been in Chicago for some time in connection with the management of the Jones Underfeed Stoker Company, has returned to Toronto and will assume the management of the Canadian business of that company.

Mr. Thos. Proctor, late city electrician at Fort William, Ont., was a recent visitor to the office of THE ELECTRICAL NEWS. After an experience of twelve months as a civic employee, Mr. Proctor decided to give somebody else a chance, and has now gone to fill a position in Vancouver, B. C.

Mr. F. L. Wanklyn, manager of the Montreal Street Railway, has returned from Jamaica, where, as chairman of the board of construction of the West India Electric Company, he made an inspection of the company's property. Mr. Wanklyn states that twenty three miles of the road are in operation, and he found the system in excellent condition.

Mr. W. T. Bonner, who for some years has been general manager in Canada for Babcock & Wilcox Company, of London, England, has severed his connection with that company, to engage in business for himself. During Mr. Bonner's regime the business of Babcock & Wilcox in Canada grew from a very small beginning to large proportions. We wish him continued success in his new field.

Mr. Harold Fraser, C.E., son of the late Hon. C.F. Fraser, has been selected to manage the electric light and gas plants recently taken over by the corporation of Brockville, Ont. Mr. Fraser graduated from McGill College as an electrical and civil engineer, and was entered for a post graduate course when he enlisted in the first contingent for South Africa. He spent a short time in a large manufactory of electrical apparatus in Plattsburg.

Mr. O. P. St. John, inspector of the Boiler Inspection & Insurance Co., of Toronto, recently met with a serious accident at the power house of the London Electric Company, London, Ont. Mr. St. John had inspected one of the new water tube boilers, and was getting out of the boiler when he accidentally fell to the floor, a distance of about twelve feet, striking his head on the rough edge of the brick work, inflicting a scalp wound which required twenty stitches, and breaking 3 ribs. For a time his condition was considered critical, but we are pleased to learn that he is now on the road to recovery.

## MOONLIGHT SCHEDULE FOR APRIL.

| Day of Month | Light. | | Extinguish. | | No. of Hours |
|---|---|---|---|---|---|
| | | H.M. | | H.M. | H.M. |
| — | | 3.00 | | 5.00 | 2.00 |
| 2 | No Light. | | No Light. | | .... |
| 3 | " | | " | | .... |
| 4 | " | | " | | .... |
| 5 | P.M. | 7.00 | P.M. | 9 45 | 2.45 |
| 6 | " | 7.00 | " | 10.40 | 3.40 |
| 7 | " | 7.00 | " | 11.30 | 4.30 |
| 8 | " | 7.00 | " | 0.30 | 5.30 |
| 9 | " | 7.00 | " | 1.15 | 6.15 |
| 10 | " | 7.00 | " | 2.00 | 7.00 |
| 11 | " | 7.00 | A.M. | 2.45 | 7.45 |
| 12 | " | 7.00 | " | 3.30 | 8.30 |
| 13 | " | 7.00 | " | 4.00 | 9.00 |
| 14 | " | 7.10 | " | 4.30 | 9.20 |
| 15 | " | 7.10 | " | 4.30 | 9.20 |
| 16 | " | 7.10 | " | 4.30 | 9.20 |
| 17 | " | 7.10 | " | 4.30 | 9.20 |
| 18 | " | 7.10 | " | 4.30 | 9.20 |
| 19 | " | 7.10 | " | 4.30 | 9.20 |
| 20 | " | 7.10 | " | 4.30 | 9.20 |
| 21 | " | 7.20 | " | 4.30 | 9.10 |
| 22 | " | 7.20 | " | 4.30 | 9.10 |
| 23 | " | 10.30 | " | 4.30 | 6.00 |
| 24 | " | 11.15 | " | 4.30 | 5.15 |
| 25 | " | 11.50 | " | 4.30 | 4.40 |
| 27 | " | 0.30 | " | 4.30 | 4.00 |
| 28 | " | 1.00 | " | 4.30 | 3.30 |
| 29 | A.M. | 1.30 | " | 4.15 | 2.45 |
| 30 | " | 2.00 | " | 4.15 | 2.15 |
| .. | | | | | |

Total ..........169.00

## TRADE NOTES.

A very attractive calendar has been issued by the Syracuse Smelting Works, of Montreal. In the centre are a couple of lady cyclists mounted on a tandem machine coming down a mountain side on a bar of the company's babbit metal. Below are the words, "Let 'em slide—it is frictionless."

Mr. Robert Watt, who has been the travelling representative in northern Ontario for the Waterous Engine Works Company, of Brantford, has been appointed the company's Toronto agent.

The Crows Nest Pass Coal Company have ordered from the Robb Engineering Company, of Amherst, N. S., a 250 horse-power engine for their mine at Fernie, B. C. This is the second engine of this size supplied them within a few months.

Nearly fifty representatives of the International Correspondence Schools visited Scranton, Pa., early in February and were entertained by the schools. Among them were men from Portland, Me., to Winnipeg, Manitoba. The schools have 300,000 students residing in all parts of the world, and as instruction is carried on by mail a large staff of instructors and correspondents is required at the home office. A day was spent by the visitors inspecting the school buildings, which are among the largest and finest in Scranton. Several meetings were held and addresses made by Mr. T. J. Foster, president of the schools, and by a number of the principals. In the evening a banquet was given at the Hotel Jermyn. Almost every visitor brought a letter from a student with whom he was personally acquainted, and the reading of these letters telling of better positions, larger salaries and other benefits secured by students as a result of their studies, was a glowing tribute to the successful methods of the schools.

## TECHNICAL EDUCATION BY MAIL.

Ambitious men who desire to obtain better positions and higher wages should carefully investigate the free scholarship offer made in another column by the American School of Correspondence, Boston, Mass. This well-known school, situatedat a recognized industrial and educational center, has among its instructors men who are regular teachers in several of the great technical schools of Boston, and has unusual advantages for teaching the theory of trades and engineering professions. Their free scholarship for engineering and mechanical drawing is a feature which should attract attention. Without leaving home or losing time from his regular work, the student pursues a thorough course of study under the direction of able instructors. Papers guiding him in his work are prepared and delivered to him. These papers, free from the technicality that usually encumbers text-books, are clear and concise in language and much superior to the ordinary text-books on the subjects on which they treat. Besides this, special information concerning any difficulties which may arise in their course is furnished to the students. Altogether, the course of study outlined is exceedingly attractive, and long experience has shown that no other method so fully meets the requirements for men who have but little time for study as that of teaching by mail. Notice the school's advertisement on another page.

The fifty-fourth annual meeting of the Montreal Telegraph Company was held in Montreal recently. A very satisfactory statement was presented. Mr. Andrew Allen was elected president, and Mr. Hugh A. Allen vice-president.

## AN OMISSION.

Through an oversight, the name of the writer of the letter in our February number under the caption of "One of the First Automobiles," was omitted. The name of Charles Baillairge, the well known architect and civil engineer, of Quebec, should have been attached thereto. The full measure of credit is due the inventor of what was at that time considered a most novel and interesting piece of mechanism.

## SPARKS.

William Sleeth, engineer at the Rossin House, Toronto, is nursing a broken arm, the result of a fall at the corner of King and Simcoe streets.

The Laval Electric & Power Company has been incorporated, with a capital of $100,000. W. H. Garth, Eugene S. Manny, and others of Montreal, are the applicants.

Alex. McFarlane, a locomotive engineer, son of James McFarlane, engineer of the Hamilton waterworks pumping house, was accidentally killed in the Chicago and Erie railway yards at Chicago by being struck by an engine.

The Citizens Light & Power Company, of Montreal, held their annual meeting recently, at which a dividend of 5 per cent. per annum was declared. Officers were elected as follows: President W. McLea Walbank; vice-president, J. H. Burland; secretary, Robert Whyte.

The city council of Halifax, N. S., have decided to establish a municipal electric plant, to supply municipal and commercial lighting, and thus to enter into active competition with the Halifax Electric Tramway Company. The estimated cost of a suitable plant is $100,000. A site has been selected for the power house.

Mr. A. H. Bruce, C. E., is making surveys of the Chats water power at Fitzroy Harbor, Ont. Among the streams which add materially to the Chats power are the Carp river, the Bonnechere river, and three or four othes streams running east into the harbor. Mr. Louis Simpson, late of Valleyfield, Que., is one of the parties interested in this proposed development.

A new rotary snow plow was put in operation this winter on the Montreal Street Railway system. It is built like an ordinary freight car, but is not more than twenty feet in length. A steel hood is attached to the front of the car, and in this revolve two electric fans which throw the snow to either side of the track or to one side only, at the pleasure of the operator.

We are told that Prof. V. F. Emerson, of Ottawa, has invented an incandescent oil lamp for which wonderful results are claimed, such as the operation of a lamp of 600 candle power at a cost of one-tenth of a cent an hour. The light is generated entirely from coal oil, and it is claimed that the expense of operating the new light will not exceed the cost of an ordinary carbon in an arc electric lamp.

Judge Brown, of the United States Circuit Court, has decided against the American Bell Telephone Company in the famous Berliner patent case. The suits were the Bell Tejephoné Company against the National Telephone Manufacturing Company and others, and same against the Century Telephone Company, brought to restrain respondents from selling, using or making telephones or teleponic apparatus with the microphone attachment, and to account to the Bell Telephone Company for past use, manufacture and sales, upon the ground of an infringement of patent.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. XI. APRIL, 1901 No 4.

## THE SNOQUALMIE FALLS TRANSMISSION PLANT.

Of the several transmission plants in operation on the Pacific coast, one of the most important and interesting is that of the Snoqualmie Falls Power Company, located in the state of Washington—important on account of its magnitude, and interesting on account of its several novel features and constructive details, the most notable being the subterranean generating station and the use of aluminum wire for the transmission lines.

The height of the falls is 267 feet, exceeding the Niagara Falls by 100 feet. About one-quarter of a mile above the falls a series of readings were taken, and the average velocity obtained was about ten feet per second. The rock at the falls is basaltic, with no regular cleavage, is hard and non-absorbant, and apparently is divided into great ledges by seams. These conditions led to the adoption of the scheme of placing the entire generating plant in an underground chamber, as shown by Fig. 1, thus removing the necessity of having a long flue or pipe line, as is usually required.

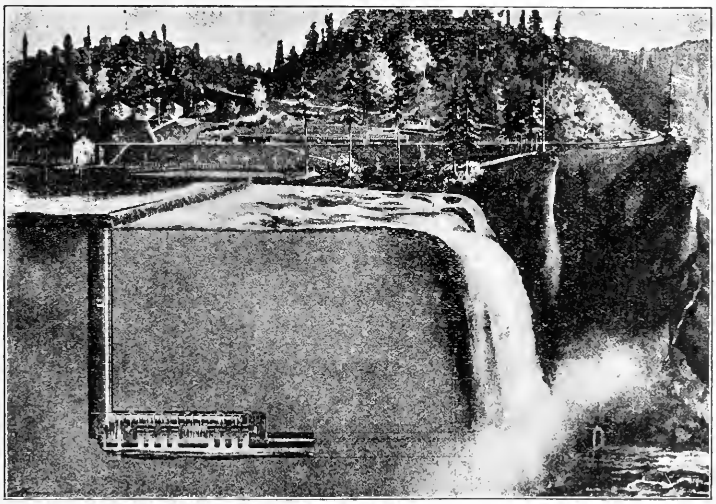

FIG. 1.—SUBTERRANEAN GENERATING STATION, TAIL RACE TUNNEL AND FALLS.

The great falls of the Snoqualmie river are situated twenty-five miles easterly from Seattle, in the foothills of the Cascade range. From a heavily timbered watershed of about 600 square miles in area on the westerly slope of the Cascade mountains, and reaching an altitude of over 8,000 feet, flow the three principal tributaries of Snoqualmie river, which unite about three miles above the falls, forming the river proper. These rivers have their origin in the region of perpetual snow and ice, and are fed by tributary streams which also originate in lofty regions and are fed by means of the snow and ice. The maximum flow of the Snoqualmie river is 160,000 cubic foot seconds, and the minimum flow 10,000. The river does not freeze, so that floating and anchor ice are unknown. Although the water reaches as low a stage at the falls as 30,000 horse power, a uniform flow of 100,000 horse-power is obtainable throughout the year by the utilization of natural storage basins. The average rainfall at the falls is about 90 inches per annum.

### HYDRAULIC DEVELOPMENT.

The water is taken direct from the river into the intake, a massive concrete and steel construction, about 60 feet along the river. It is built upon the solid rock formation of the river bed, with walls six feet deep and twenty-five feet high. To keep out floating logs and trees the front of the intake is protected by a timber grating supported by a steel girder frame built into the concrete. The forebay thus formed is divided into two headbays separated by a concrete wall six feet thick, both equipped with a massive timber bulkhead and head gate, having an opening 8x12 feet, through which the water flows to the penstocks. The active headbay is further protected by a screen made of flat steel bars on edge, and the timber grating is protected from floating logs by a floating fender in the form of a rudder boom 300 feet long, which is moored above the intake

and extends past it. For a considerable distance up and down the stream the river banks are protected by massive timber bulkheads constructed of sawed cedar 12x12 inches laid horizontally.

For the purpose of raising the low-water elevation of

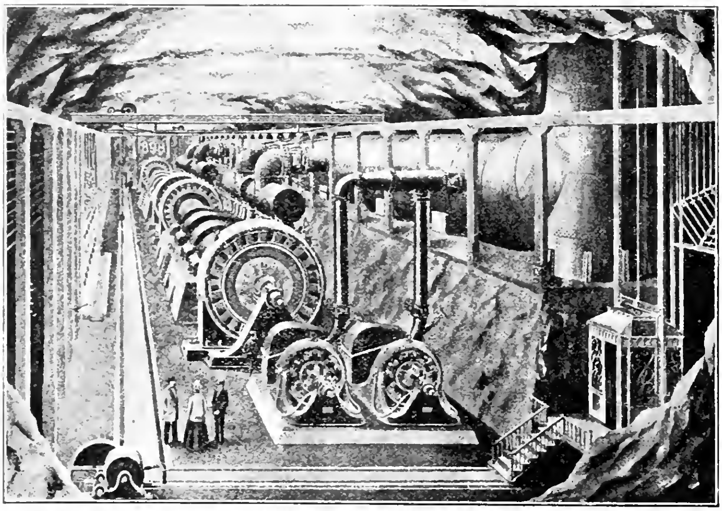

FIG. 2.—UNDERGROUND MACHINERY CHAMBER.

the river at the top of the penstock to a depth of a minimum of eight feet, a dam was constructed across the river about 200 feet below the intake and 200 feet above the crest of the falls. At each end of the dam is an abutment pier eight feet square and five feet in height above the crest of the dam. This elevation is also that of the lower bulkhead, which below the dam is continued in the form of a heavy concrete retaining wall, with an average batter of one-half to one. Thus is formed a spillway over which the water freely flows whenever it exceeds a depth of five feet over the crest of the dam, and allows for the discharge of flood waters without unduly raising the surface of the river above the dam.

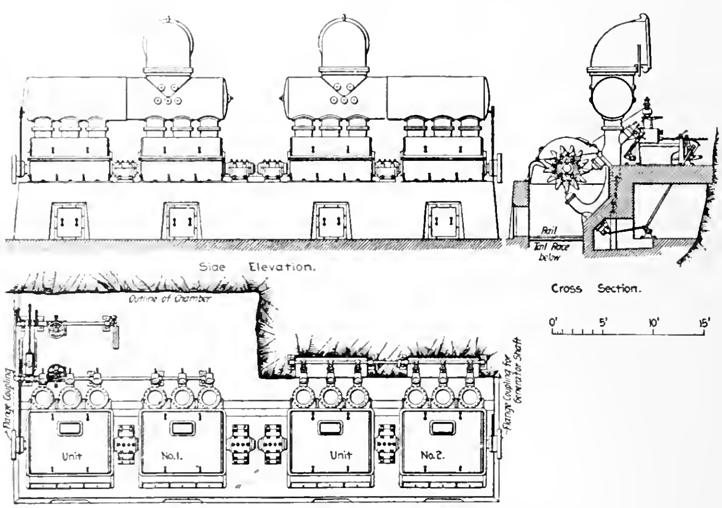


FIG. 3.—ELEVATION AND SECTION OF WATER MOTORS.

THE SUBTERRANEAN POWER HOUSE.

About 300 feet above the falls a shaft 10 x 27 feet was sunk in the bed of the river on the south side, descending 270 feet to the level of the river below the falls. While this shaft was being excavated, a tunnel 12 feet wide and 24 feet high, with a fall of 2 feet in its entire length, was drifted in from the face of the ledge below the falls to an intersection with the bottom of the shaft, a distance of 650 feet. Beginning at the foot of the shaft and extending over and along the tunnel, a chamber 200 feet in length, 40 feet wide and 30 feet high, with the floor at the elevation of high water below the falls, was excavated out of the solid rock. This chamber forms the power house in which the water wheels and electric generators have been installed. The tunnel extends under the floor of the chamber, forming a tail-race, with a concrete roof five feet thick. About 700 incandescent lamps are used to light the shaft, chamber, and tunnel.

The top of the shaft is divided into three compartments; the two end compartments are for the penstocks, while the centre one forms a shaft 8x10 feet for the hydraulic elevator and the main cables forming the outgoing conductors, and also for raising and lowering machinery, etc. The penstock and receiver is a steel pipe 7½ feet in diameter and 250 feet in length. Reaching the chamber, it connects with a horizontal cylindrical receiver which rests on a rock bench in the north side of the chamber, 12 feet above the floor. The penstock and receiver weigh 225 tons, and the weight of the water column in the penstock is 340 tons. The receiver is 10 feet in diameter for half its length and eight feet for the remainder.

THE MAIN HYDRAULIC PLANT.

The main generating units are said to be the largest and most powerful tangential wheels thus far attempted under similar head. They consist of four units, each developing 2,500 horse-power and being direct connected to its generator. The receiver of each unit has four supply openings, which are controlled by individual double-screw gate valves of 48 inches inside diameter and weighing 23,000 pounds each. This receiver is hori-

zontal, and the openings are on its side and open towards the cavity. Bolted direct to the gate valve is an elbow casting, 48 inches insid ediameter, that directs the water directly downward into the distributing receiver.

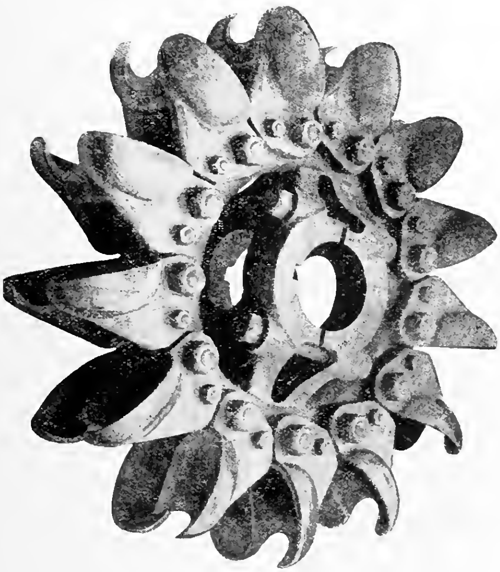

FIG. 4.—ONE OF THE DOBLE WATER WHEELS.

The elbows are bolted directly to the flanged opening of the distributing receiver. The water enters the distributing receiver flowing in a downward direction, and without changing this general direction is discharged from the six openings along the bottom into the six multiple nozzles that direct and regulate the water that is applied to the wheels. Figure 3 shows a view of the exciter wheel and regulating nozzle.

The distributing receiver is directly over and supported by the six regulating nozzles standing upright upon the foundation, and the water is discharged from the distributing receiver into the nozzle without any change in direction. The nozzles stand upright on the foundation, and the extreme or lower end is curved so as to direct the water upward against the wheel, the end of the nozzle terminating in a tip. Each nozzle has two tips, each tip discharging a jet of 3⅞ inches in diameter. The first tip is at the upper end of the nozzle and discharges the water in a downward direction against the wheel.

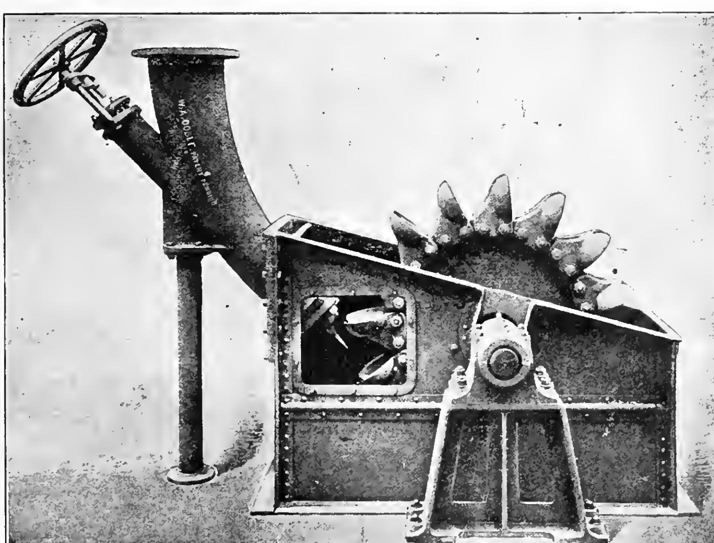

FIG. 5. EXCITER WHEEL AND REGULATING NOZZLE—HOUSING OPEN.

To handle the volume of water necessary to develop the power in each unit under the head of 225 feet, requires twelve jets, dischaging against six wheels, there being six wheels in each unit. For convenience of bearing and shaft design, these wheels were divided into two groups of three wheels each, each group being in a separate housing with a bearing between. The regulating tips used on the nozzle give an absolute control over the quantity of water applied to the wheels ; therefore over the power output of the unit. As the nozzles are controlled by the governor, they give a perfect speed regulation with variable load at a high efficiency. The regulating nozzles are operated from two long rocker-shafts by means of cranks and connections. The six wheels have split hubs and solid ribs ; they are 45 inches in diameter and are provided with buckets of the ellipsoidal type. The 13 buckets used are attached to the wheel rim by fitted bolts, so that the buckets can be replaced when they become worn from scour or otherwise deranged. This is claimed to be an advantage over wheels of the turbine type where the buckets are part of the wheel casting. The six wheels are keyed on the shaft in two groups of three wheels each. The shaft is supported in two bearings of the ring-oiling removable shell type. One bearing is at the extreme end of the shaft, and the second in the middle of the shaft length and between the two wheel housings. The generator bearing carries the other end of the shaft through the shaft coupling.

Each wheel unit weighs about 100,000 pounds. The wheels operate at 300 revolutions per minute. The foundations are built of concrete, and are cemented solidly into the floor and one side wall of the cavity. The tail-race for the discharge water from the wheels is excavated beneath the foundation, so that the waste water drops from the wheels into the tail-race and flows out to the river below the falls. The foundation for each unit is divided into two compartments corresponding to the two wheel housings.

The exciters are of 75 kilowatt capacity and are direct connected to the tangential ellipsoidal water wheels of 45 inches diameter. The wheels are mounted in steel usihongs and are supplied with water through a regulat-

ing nozzle of three inches jet diameter. The water is carried to each exciter through a vertical pipe 12 inches in diameter, so that the nozzles are in an upright position. To permit of cleaning the armature of the generators while working, compressed air is furnished by a vertical type air-compresser, with an 8 x 10 inch cylinder.

Although the plant has an output of 10,000 electrical horse power, the main receiver and connections, water wheels, generators, travelling cranes, exciters, elevator gear, switchboard, and all auxiliary apparatus are contained in a cavity of 40 feet wide, 30 feet high and 200 feet long, while the entire station output is regularly operated and cared for by two men on a shift, one an electrician on the switchboard and in charge of the station, and the other an oiler whose principal work is one of inspection and keeping the entire station in good order.

ELECTRICAL EQUIPMENT.

The generators in the power house, of which there are four, are of the Westinghouse revolving armature, 1,500 k. w., two-phase type, 7,200 r. p. m., 1,000 volts. Each generator weighs about 100,000 pounds and stands 14 feet high. The normal full load current is 1,000 amperes per conductor. The armature winding is a closed circuit, and consists of 266 bars with one bar per slot. The armatures are 96 inches in diameter, weigh approximately 24,000 pounds each, and operate at 300 r.p.m. Massive collector rings of the ventilated type deliver current to the external circuits. Three brushes bear on each ring, and to ensure equal division of current between them in case of unequal contact resistance, separate cable leads of considerable length connect the brushes and the outside circuit, in order that the fixed resistance with each brush may be large compared with the possible variable resistance. In these armatures about 4,500,000 foot-pounds of energy are stored at 300 r.p.m., and from the construction of the water motors the moving water column also contributes to the stored energy, since it operates directly upon the revolving parts of the water motors.

There are two separate 125 volt, 75 k.w. exciters, each being more than sufficient in capacity to supply field current to all four of the generators. These exciters are each separately driven by a 100 horse power wheel, mounted in steel housings.

The switch-board is of white marble, with mountings of brass and bronze. It has eighteen panels, four for generators, two for the exciters, and twelve for the feeders, also two sets of busbars so that different classes of load may be carried separately. Each generator panel has circuit breakers on two of the three phases, synchronizing and pilot lamps, field ammeter, a main ammeter on each of the three circuits, indicating wattmeters of the Niagara type, a field rheostat, double-throw three-pole switches, and voltmeter and ground detector plugs. The exciter panels carry ammeters, circuit breakers, ground detectors, voltmeter plugs and rheostats, and the feeder panels have circuit breakers, ammeters and a double-pole double-throw switch. The switch-board also carries three alternating current voltmeters on swinging brackets, by means of which the voltage in any phase of any generator may be read.

From the feeder panels of the switch-board 24 aluminum cables are provided for conducting the 1,000 volt current up the elevator shaft to the transformer house. There are 12 raising transformers of the standard Westinghouse self-cooling, oil insulated type, 550 k. w. capacity each. The primary winding is for 1,000 volts, and the secondary winding for either 15,000 or 30,000 volts. Each transformer weighs 10,850 pounds, and is supplied with two high tension fuse circuit breakers by which it may be disconnected either by hand or automatically in case of excessive current load. The three phase current is delivered to the line by the Scott system.

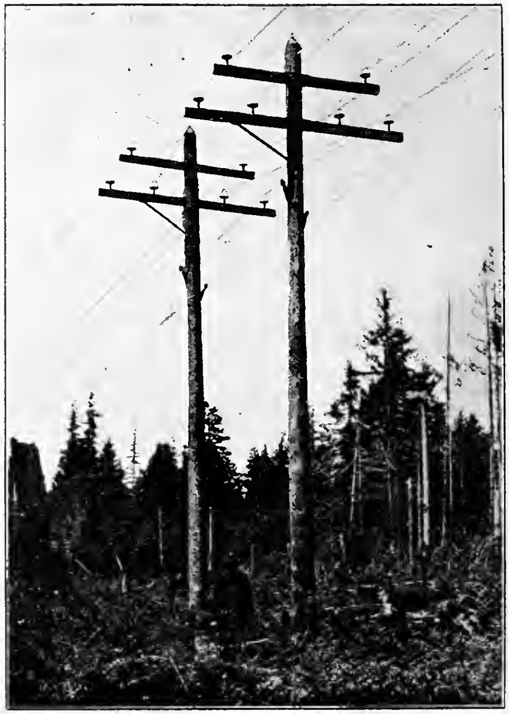

FIG. 6.—METHOD OF LINE CONSTRUCTION.

THE POLE LINE.

The transmission wires of the pole line are of aluminum. The conductivity of aluminum is about 60 per cent. of that of copper, so that the aluminum wire, in order to have a capacity equal to copper, must have a cross section about 66 per cent. greater, but with this increased size the weight is claimed to be slightly less than 50 per cent. that of copper. The tie wires are of soft No. 8 B. & S. gauge aluminum wire. The length of the line to Seattle is 31 miles, diameter 26 inches, and the total weight of wire 67,000 pounds. The line to Tacoma is 44 miles in length, 23 inches in diameter, total weight 72,000 pounds. There are two three-phase three-wire circuits to Seattle and Tacoma respectively.

The poles are of cedar, 9x13 inches x36 feet and upwards to 154 feet. The lines are carried on triple petticoat Imperial porcelain insulators 4½ inches high and 6½ inches in diameter, weighing four pounds each, furnished by C. S. Knowles, of Boston. The pins are of locust, boiled in paraffin oil. Two circuits are run on each pole line, one on each side, with a triangular spacing of 30 inches between the wires. The length of span on the Seattle line is 90 to 150 feet, the average being 110 feet. On the Tacoma line the average span

is 150 feet. A winter sag of about 15in. is allowed, this being considerably greater than is common practice with copper wires. The ohmic resistance on the Seattle line is from 84.5 to 88 ohms, and on the Tacoma line 76 ohms.

THE SUB-STATIONS.

The first sub-station is at Isaquah, 10 miles from the power-house, from which current is distributed for lighting the town and furnishing power to the coal mines. It contains a step-down transformer of 50 k.w. capacity and from 30,000 to 2,000 volts with variable secondaries, the current therefor being taken from one phase of one of the Tacoma circuits. The next sub-station is at Renton, nineteen miles distant, and contains an equipment similar to that at Isaquah. In the terminal sub-station at Seattle there are at present three step-down static transformers, with primaries and secondaries in delta connection, for supplying 350 volt current to the 500 volt rotary transformers. There are also four pairs of 2 phase to 3 phase lowering transformers of 300 kilowatts capacity each, and 2 pairs of 500 kilowatts each, with 2,000 volt secondaries for general lighting and power distribution, which makes the total station transformer capacity 3,700 kilowatts. They are 2 rotary converters of 500 kilowatts capacity delivering current at 550 volts, which are operated in multiple on both alternating and direct current sides. The switch-board contains the cnstomary apparatus for controlling the transformers. For alternating current lighting and power-motor work a panel is provided for each set of 3 phase 2 phase transformers, containing two 2,000 volts automatic circuit breakers, 2 ammeters, 2 Niagara type indicating watt-meters, 2 double-pole throw switches and pilot lamps. The Auburn sub-station, thirty-one miles from the falls, contains a 50 kilowatt lowering transformer, and the Tacoma station is equipped with three 500 kilowatt transformers and two 200 kilowatt transformers, similar to those at Seattle.

TESTS ON THE 153-MILE LINE.

By the use of the plug switching boards at the generating station and at the Renton sub-station, and of paralleling switches at the Seattle and Tacoma sub-stations, it is possible to form a single continuous three phase circuit from the generating station at the falls to Seattle, back to the falls, to Tacoma, and back to the falls, a total distance of 153 miles. A short time ago such a connection was made, and the record feat of driving a motor 153 miles distant from the generator performed. The test was made to show that electrical transmission of power can be made commercially practical at much greater distances than has heretofore been contemplated.

With the 153-mile circuit open at the in-coming end, the tests were made for charging them at different voltages, the alternation (7,200) being kept constant. It was found that as the voltage increased the charging current rapidly increased; at 22,000 line voltage it required 62 kilowatts to charge the line, at 30,000 volts 112 kilowatts, and at 35,000 volts 180 kilowatts. With the lowering transformers at the falls cut in and their secondaries open, the current required to charge the line increased; at 22,500 volts it required 76 kilowatts, and at 30,000 volts 123 kilowatts. The voltage at the in-coming end of the circuit, with charging current only on the line, was greater than on the outgoing; 22,500 volts out gave 24,600 in, and 30,000 volts out gave 32,100 in.

Tests were also made to determine the different amount of charging current required at different frequencies, the voltage being kept constant at 30,000, and it was found that at 6000 alternations 100 kilowatts were required to charge the line; at 6600 alternations, 105 kilowatts; and at 7800 alternations, 115 kilowatts.

The line was then tested for loss of power in transmitting a non-inductive load, consisting of the water rheostat at the falls at the end of the 153-mile circuit. It was found that the line voltage out was 30,000, incoming 22,500, drop 25 per cent. The amperes per phase at 1000 volts out was 624, incoming 354, loss 11.2 per cent. The total kilowatt outgoing was 1100, incoming (that is delivered into the water rheostat tanks) 723, loss 34.2 per cent.

A test was also made for charging current with the sub-station transformers at Seattle and Tacoma, and the lowering transformers at the falls in circuit, but with secondaries all open, and it was found that with the 30,000 volts out, there was 31,500 volts in, and that it required 193 kilowatts to charge the line. A test was then made of operating a second generator as a synchronous motor at the end of the circuit, and the machines were synchronized without any trouble whatever; but they soon began pumping, so that it was found advisable to separate the machines. During this test the outgoing line voltage had varied from 26,000 to 27,000 and the incoming from 24,000 to 26,700, giving approximately a drop of six per cent., the amperes per phase at 1000 volts out being approximately 900; incoming, approximately, 650; loss, approximately, 27.7 per cent. Total kilowatts out, 432; incoming, 374; loss, approximately, $13\frac{1}{2}$ per cent.

The expiriment was then tried of operating the water rheostat and the synchronous motor in multiple at the end of the 153-mile circuit, and the performance of the motor was very much improved. The water was then shut off from the water wheel and the driven motor at once reverted to a generator driven by its own inertia.

The above description, together with the accompanying illustrations, are reproduced from the Journal of Electricity, Power and Gas, of San Francisco.

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A by-law will be submitted to the ratepayers of Thessalon, Ont., to provide funds with which to install an electric light plant.

Mr. A. H. Bertschinger, who has been connected with the Ottawa Electric Company for some years, has opened an office as electric contractor at the corner of Slater and Elgin streets, Ottawa.

The city of New Westminster, B. C., owns its electric light plant, and has recently adopted new regulations affecting the use of the electric light. These regulations provide that the following charges and conditions be adopted and incorporated in the agreement between the corporation and the consumers in all application for light supplied: (a) All current supplied shall be measured by meter and a rental of 25 cents per month shall be charged for all meters. (b) On all meter accounts paid at the office of the City Treasurer on or before the tenth day o. month a discount of 20 per cent. will be allowed on the previous month's account, provided all arrears due by the consumer to the Electric Light Department are paid up. Rates will be as follows: On a monthly consumption not over 30,000 watts, the rate per 1,000 watts shall be 15 cents; over 30,000 and not exceeding 60,000 watts, 14 cents; 60,000 to 100,000, 12 cents; over 100,000, 11 cents. (c) All meters and the fittings belonging thereto are and remain the absolute property of the city, and are held in trust by the consumer, who hereby agrees to pay for all damage dene to the said meter and to protect it from interference or removal by other than the city's officers during such time as it shall be installed within or upon the premises.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
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*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**The London Metropolitan Underground.**

A CABLE just received announces that the contract for the electrical equipment of the Metropolitan underground railway in London, England, has not yet been finally awarded to the Ganz Company. Mr. Yerkes is said to be strongly opposed to the proposed high-voltage alternating system, and it is thought has obtained control of sufficient stock to prevent its adoption. His object is to establish a uniform American continuous current system on the Metropolitan line in connection with London's "tupppenny tubes."

**An Edison Storage Battery.**

EXCESSIVE weight has been a great drawback to the storage battery. Naturally, therefore, the daily press reports, which seem to be borne out by facts, that Edison has in process of completion a new type of storage battery of lesser weight, has created considerable interest, for two reasons, first, in view of the success which he has achieved in other electrical inventions, and secondly, for the reason that in late years he has almost entirely avoided the storage battery problem. According to a description which appears in a German paper, Mr. Edison's battery is not a lead accumulator, and the chemical actions in it are said to be quite different from those in the ordinary storage battery. The voltage is given as 0.44, which is a little more than a fifth of the voltage of the ordinary accumulator and corresponds approximately to that required by theory. As depolizer, the lower oxide of copper is used, and as negative electrode finely divided cadmium. Mr. Edison is reported as having stated that he would reduce the weight of the modern battery by one-half and the depreciation to one-tenth, results which, if accomplished, would give a veritable boom to the storage battery.

**The School of Pracal Science.**

It is gratifying to state that the Ontario government have promptly responded to the request of the students and interested bodies for increased accommodation and better equipment at the School of Practical Science, Toronto. The goverment's determination to erect an entirely new building for the purpose is a wise one. The estimated cost is $200,000, but a larger sum will be expended if the requirements should demand it. The designing of a building for such a purpose will afford scope for architectural ability of a high order. Probably the most satisfactory method of procuring a carefully designed and planned building expressive of its purpose and adapted to the requirements, would be to institute a competition for designs under conditions to be approved by the Ontario Association of Architects. The government should give the winner of the competition opportunity to inspect the most important buildings of similar character in the United States, the desirable features of which should be incorporated in his plans. The determination to spend so large a sum upon the erection of a building, the equipment for which will call for a further considerable expenditure may be taken to mean that the government propose to establish one thoroughly efficient scientific school in Ontario, instead of dividing the money at its disposal between two or more institutions. We strongly sympathize with the idea. Let us have one provincial university and one scientific school which will compare favorably with those of other countries, rather than a number of such institutions

which because of insufficient revenue must necessarily be more or less inefficient.

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**Electricity and Industrial Development**

Of the early electrical companies practically all were organized for the sole purpose of supplying current for lighting. Later came the application of electric power for railway purposes, and following this, its more general application for power work of many kinds. While there has been an immense development in the electric lighting business, the indications are that there will be witnessed a still greater development in the application of electricity in the industrial field. To-day water powers are being developed for the production of electricity where there is no prospect of any considerable market for the current outside of industrial enterprises, the lighting demand being given little consideration. If there are any who consider that the expansion of the electrical business in Canada is nearing its crest, a study of the industrial development which is taking place, and the relation of electricity to it, will surely lead to a different conclusion. Take for example the undertakings at Sault Ste. Marie, Ont., and Shawinigan Falls, Que., where electricity has been a most important factor. Another example is to be found at the cotton mills at Valleyfield, and many others might be enumerated. Electricity is, in fact, becoming more generally employed every day, and is fast superseding steam as a motive power in industrial operations. It is even being applied to the operation of saw-milling and wood-working machinery. Pulp and paper making is another branch of industry in which electricity has been and will be even more largely used. This prospective development is most encouraging, indicating, as it does, an increased demand for electrical goods of all kinds.

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**Gas Engines.**

Of late there seems to have been a pronounced recognition of the merits of the gas engine in connection with the operation of electric lighting and power plants. Manufacturers have given more attention to perfecting the gas engine, and have brought it to a point of development where it is now a strong rival to the steam engine. In this country it is now largely employed for purposes where a small amount of power is required ; but the tendency of the times appears to be towards its more general adoption in larger units operated by producer gas. Advantages of the gas engine are that it occupies less space than an equivalent steam plant, requires less attention, and, according to the claims of the manufacturers, shows a higher efficiency. Modern engineering also inclines to the opinion that in the near future higher attainments in efficiency will be reached by the use of the gas engine than by any other means. It is significant that we find gas engines operating electric railway power plants, inasmuch as one of the chief arguments against the use of the gas engine has been its inability to regulate satisfactorily with rapidly varying loads. While on this continent the gas engine seems only to be in its incipient stage, it has undergone a much greater development in Europe. Mr. Philip Dawson has contributed a series of articles on "Some Existing Gas Driven Power Plants," from which it is learned that for over twenty years large electric lighting plants in Europe have been driven by gas engines. In 1881 the Continental Company, of Dessau, completed an installation in connection with its work containing three gas engines belted to a counter-shaft which was connected to four dynmos. A gas engine driven plant which is described as possessing features of particular interest was installed in 1894 at Zurich to operate the Zurich Bergbahn electric railway, opened for service in February, 1895. The power plant consisted of two 33-kilowatt compound-wound generators, each driven by a belt from a 50 horse-power Crossley gas engine, and supplying current on the line at a pressure of 550 volts. The same system was adopted on a much larger scale at Lausanne in 1896. In Europe there has been a constant tendency towards enlarging the size of the gas engine, also towards using it in combination with storage batteries.

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**Government Ownership of Telegraphs.**

During last month the fact was made public that the Dominion Government have under consideration the question of assuming control of the telegraph systems of this country. The matter has not yet taken tangible form, and it is not probbale, in view of the lengthened absence of the postmaster general who is now on his way to Australia, that any action will be taken at the present session of parliament. The proposal that the telegraph systems of Canada should pass into the hands of the government is no doubt the outcome of the project to connect all parts of the empire by cable and telegraph under government supervision and control. The Canadian postmaster general is favorable to this project and to the construction of a Canadian cable. It will perhaps be remembered that Canada is the only British colony where government ownership of telegraphs does not exist, and therefore, as stated, the idea no doubt is to complete the missing link. There are difficulties in the way however. In Canada we have two commercial telegraph systems, one of which forms part and is operated in connection with the Canadian Pacific Railway. It would be a comparatively simple matter for the government to buy up the stock of the Great North-western, Dominion and Montreal Telegraph Companies, but it would be a more difficult matter to purchase the Canadian Pacific Telegraph system at a fair valuation, seeing that the business is so interwoven with that of the railway. There would probably be much difficulty in distinctly separating the receipts and expenditures of the telegraph system from that of the railway in such a way as to arrive at the actual results of the operation of the system. It is apparent that should the government take over the telegraph systems, they would be obliged to acquire the long distance telephone system as well, which otherwise would preve a strong competitor. This fact adds considerably to the magnitude of the undertaking. Mr. H. P. Dwight, president and general manager of the Great North-Western Telegraph Company, was asked, in view of his long experience in telegraph management, to consult with the postmaster general with regard to this proposal, but we understand no proposition of any kind was made by the government. The object in view was simply to obtain information which would assist the government in considering the matter. The experience of the British government with the management of the telegraph system is not encouraging, the receipts of the system being £2,000,000 per year below the expenditures, notwithstanding the large and concentrated population and the enormous volume of business. This result is no doubt in a measure due to the fact that government employees have not the same chance of promotion as have those of a private corporation, consequently ambition is stifled and a check put upon efficiency.

## QUESTIONS AND ANSWERS

"R. H.," Halifax: I have been told by an agent that if I add one more wire to my single phase system the same size as the two now up and turn it into a two phase, that I can carry twice the power with the new system with the same loss. Is this correct or not?

ANS.—The loss of power in a single phase system, each of whose wires carries I amperes and has a resistance of R ohms, is $I^2R$ watts per wire, or $2I^2R$ for the complete line. If you add a third wire of the same cross section, making it the neutral of a quarter phase line, and put the same current through each of the two remaining lines, the current in this neutral will be $\sqrt{2}$ times that in either of the outsides, or $\sqrt{2}I$ amperes, and the loss will be $(\sqrt{2}I)^2R = 2I^2R$ watts, or twice as great as that in either of the other two, which, as they are carrying the same current, will give the same loss as they did in the single phase system, namely, $2I^2R$ watts. The total loss in the three wires is therefore $4I^2R$ watts, or twice what it originally was ($2I^2R$ watts), so that by adding 50% more copper you are enabled to carry twice the load with twice the actual or the same percentage loss.

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"A. B." writes: I have two circuits the impedances of which are respectively 4 ohms and 12 ohms; what will be the total impedance if I put them in series, will it be just 16 ohms?

ANS.—The impedance of a circuit is numerically equal to the square root of sum of the squares of the effective resistance and the reactance, and it is impossible to add two impedances without knowing one of the two factors which compose each of them; generally speaking, the true sum is less than the numerical.

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"Electrician" asks: What is the usual practice regarding the exciters of alternating current generators driven by water-wheel plants? Is it better to belt them to the main generator or to drive them by direct coupling to separate wheels?

ANS.—The disadvantages of direct coupling are: Usually higher cost both for the exciter, which will usually be of a slower speed than if belted, and also for the separate wheel; more wheels and piping to look after and maintain; and, if high heads are used and consequently small nozzles, the great liability of choking. The principle advantages are: Greater interchangeability, seeing that the shutting down of a generator will not affect the exciter furnishing it; the avoidance of all belt troubles; the decreasing of the floor space occupied; and greatest of all, the great improvement obtained in the voltage regulation, seeing that a change in the load and consequently the speed of the main machine will not affect the speed and consequently the voltage of a direct driven exciter, as it would were the latter belted to the alternator it excites. The efficiency of the two plans is about the same, the increased losses in the small wheel over those in the main wheel being about offset by the gain due to the absence of the belt losses.

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"E.S.," Montreal: Can you give me any convenient rule for calculating the size of a three-phase wire. I can figure out the sizes for single-phase work without any difficulty.

ANS.—Since the three phase system takes but 75% of the copper of the single phase, it follows that the area of the 3 three-phase wires must together be equal to ¾ of the combined area of the two single phase loads, or 3 three-phase = ¾ (2 single-phase), which resolved shows that a three-phase wire is but half that of a single-phase, or in other words, for the same loss over the same length of line carrying the same load, each of the three-phase wires will be half the cross-section of either of the single phase.

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"Owner": I have recently speeded up my engine, and I find that since then we have been troubled a good deal with water in the cylinder, which has come over quite hard two or three times. We never had any trouble when running at the old speed.

ANS.—Speeding up your engine virtually means that it does more work in a given time, or in other words, that the demand for steam is greater. From this increased demand it follows that if your boiler capacity is at all on the small side you are running great chances of priming and foaming, which perhaps is what is occuring. Again your engineer may be carrying his water a little too high, which tends to produce the same difficulty; or yet again, your steam main may be too small, or there may be a point in it, such as a valve or a flange coupling, the area of whose steam passage is too small, which in conjunction with the heavier demand for steam caused by the increased speed, will frequently make the engine draw over water from the boiler.

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"S. Y.," Toronto. Would you kindly advise me the best way to make the slots in the armature discs of a small motor I am building; there is no punch in the machine shop which I have available.

ANS.—You can buy from various makers discs punched with any style, size or number of slots, and this we think would probably be the best way to obtain them, but if you prefer making them yourself a simple method for a small machine is to charge them between the end plates of your armature which have previously had the slots filed out in them, and then using these slots as a guide, drill holes through the discs parellel with the shaft from plate to plate, cutting out with a back saw the top part left untouched by the drill, and then filing out the fillets left at the bottom of the slot.

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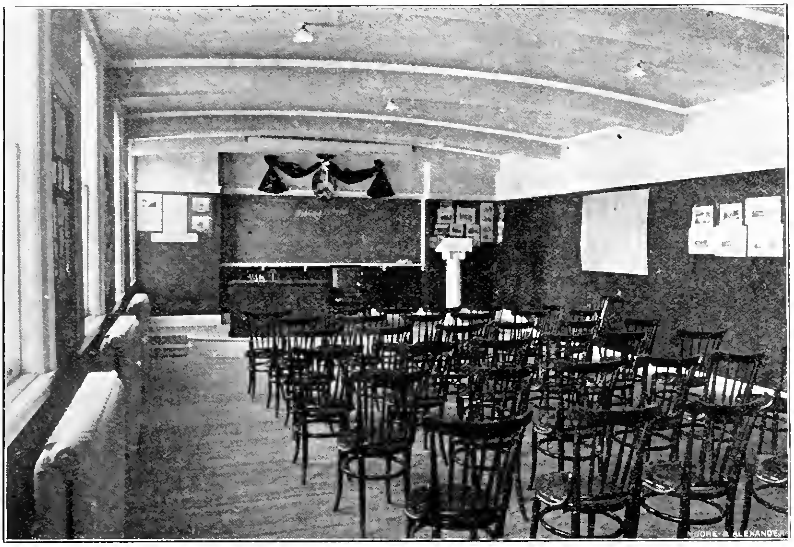
"Student" asks: What is the difference between a current transformer and a potential transformer?

ANS.—There is no essential difference, the principle action being exactly the same in both. The former is so called because it is used in conjunction with an ammeter to measure current in its secondary circuit in which is placed the ammeter, producing a current of low potential and comparatively small amount (approximately 25 amperes in ordinary work), proportional to the current in its primary, which latter may be either one of very large amperage, or else be in a circuit of unsually high potential, either of which conditions render it impracticable or undesirable to put this primary current itself through the instrument. The potential transformer gets its name from being used together with a voltmeter to measure potentials which are too high to allow of the latter being connected directly across them.

## CARE OF BOILERS.

WHATEVER plan is adopted for securing water to feed the boilers should not interfere with the general plan of feeding at the same rate that the steam is used, so



ROOMS OF THE ONTARIO ASSOCIATION OF ARCHITECTS AND TORONTO ENGINEERS' CLUB, 94 AND 96 KING STREET WEST, TORONTO.

that the water line will remain nearly in the same place at all times.

In every plant where there are two or more boilers, it is sometimes necessary to lay off one of them for cleaning or repairs. In fact, every plant should have an extra boiler to use in case of necessity, and this means whenever it is advisable to clean one of them, as the practice of running boilers almost continuously should be discountenanced on all convenient occasions.

ROOMS OF THE ONTARIO ASSOCIATION OF ARCHITECTS AND TORONTO ENGINEERS' CLUB, 94 AND 96 KING STREET WEST, TORONTO.

The plan of leaving boilers empty is a good one, provided steam and water are excluded from them. This opinion is based on experience in starting up a boiler that had not been used for fourteen years, for no internal corrosion was found in it, while the external parts were but slightly affected by its long rest. It was set in brick according to common practice, two walls of the building serving as part of the setting. After it had been thoroughly inspected it was run for several years under as much pressure as a new boiler of equal diameter is usually allowed in this vicinity without calling for repairs except tightening two braces, and probably this was needed before it was laid off.

When boilers are to be left idle for a long time they should be thoroughly cleaned, as soot collects and holds moisture, so that corrosion goes on underneath the apparently harmless covering until the plates are ruined. A coat of good paint suitable for ironwork will assist greatly in preserving boilers out of use, and as the expense of it is small, it does not pay to neglect it, for good second-hand boilers are frequently wanted by parties who do not care to invest in new ones for reasons of their own ; but when corrosion is allowed to eat into the tubes and plates they will soon be fit for the scrap heap only, and are not especially valuable even there.

One advantage of a power pump and a driven well in connection with a good heater is that all the pumping must be done before the engine is shut down, which means that exhaust steam is passing through the heater, and no cold water can reach the boiler. An injector, says the Boilermaker, of London, is very convenient in such a plant, because it may be run to fill up the boiler after the engine is shut down.

# TELEGRAPH and TELEPHONE

## THE OLD TIME TELEGRAPHERS' ASSOCIATION.

The Old Time Telegraphers' Association is an international society organized about twenty years ago for the purpose, as stated in the preamble, of preserving early memories incident to the unfolding of the science and art of telegraphy. The Association has a membership of nearly one thousand, the representation from Canada being as follows: J. J. Ahearn, Ottawa Electric Railway Company, Ottawa; Thomas Ahearn, Ottawa Electric Railway Company, Ottawa; William J. Brown, Canso, N. S.; W. J. Camp, C.P.R. Telegraphs, Montreal; C. D. Dewar, Bell Telephone Company, Montreal; H. P. Dwight, G.N.W. Telegraph Company, Toronto; R. F. Easson, G.N.W. Telegraph Company, Toronto; J. D. Fraser, Ottawa Electric Railway Company, Ottawa; C. R. Hosmer, Montreal; J. E. Hutcheson, Ottawa Electric Railway Company, Ottawa; James Kent, C. P. R. Telegraphs, Montreal; L. B. McFarlane, Bell Telephone Company, Montreal; W. B. Powell, G.N.W. Telegraph Company, Montreal; W. Y. Soper, Ottawa; F. H. Waycott, Anglo-American Telegraph Company, Montreal; Thos. Rodger, G.N.W. Telegraph Company, Montreal. At the twentieth annual re-union of the Association held in the city of St. Paul, Minnesota, on September 20th, 1900, it was decided that the next annual meeting should take place in the city of Montreal in September next. Thus for the first time the Association will meet in a Canadian city. Mr. L. B. McFarlane, of Montreal, was elected to the honorable position of president of the Association for the year 1900-1901, and Mr. J. E. Hutcheson, of Ottawa, to that of vice-president. Messrs. Thomas Ahearn, of Ottawa, and James Kent, F. H. Waycott, W. J. Camp, and W. B. Powell, of Montreal, were chosen as members of the Executive Committee.

Mr. L. B. McFarlane,
President Old Time Telegraphers' Association.

Mr. L. B. McFarlane entered the service of the Montreal Telegraph Company in 1865, working his way up to manager. In 1870 he resigned and accepted an offer from the Western Union Telegraph Company at Detroit, Mich., to become night-press operator, and later was employed for the company at New Orleans and Nashville, Tenn. In 1875 Mr. McFarlane was appointed manager at Toronto for the Dominion Telegraph Company, and upon the advent of the telephone became superintendent of the Dominion Telegraph Company's telephone department. He organized and put into operation telephone exchanges in the principal cities and towns in the Dominion. Upon the organization of the Bell Telephone Company, he was appointed manager of the eastern department of that company, which position he held for sixteen years. In 1896 he was promoted to the office of general superintendent of the Canadian telephone system. Mr. McFarlane is a director of the Wire & Cable Company and the Northern Electric & Manufacturing Company.

Mr. Hutcheson is superintendent of the Ottawa Electric Railway Company. He began his telegraph career in April, 1874, as night operator at a small station on the Grand Trunk Railway, and served with that company until February, 1884, when he resigned to accept the position of train despatcher for the C. P. R. at Ottawa. In 1888 he was appointed train master of the eastern division of that system, which position he held until April, 1891, when he resigned to accept the position he now holds. Mr. Hutcheson has had the pleasure of seeing the Ottawa Electric Railway grow and prosper under his supervision. He is one of Canada's crack marksmen, having represented his country at Bisley for several years.

## SUIT CONCERNING WIRELESS TELEGRAPHY.

The United States Circuit Court of New York has handed down a decision in favor of Prof. Marconi in the suit brought by Lyman C. Learned, of Boston, as the assignee of Prof. Dolbear, for damages to the amount of $100,000 and the issue of an injunction restraining Marconi from using apparatus for wireless telegraphy. The complaint set forth that Dolbear was the original inventer of the system, that his patents were issued in December, 1882, and October, 1886, and assigned to Learned in 1899. It was further claimed that the apparatus for wireless telegraphy exhibited in the diagrams of Marconi's patent was impractical, and that the defendant well knew this. It had, the complainant

Mr. J. E. Hutcheson,
Vice-President Old Time Telegraphers' Association.

alleges, only commercial value when one terminal grounded was used for transmission and one for receiving, and hence contracts entered into by the defendant for commercial purposes were carried out by recourse to the plaintiff's patented instrument or instruments similar. Marconi applied similar criticism to the apparatus of Dolbear, which he claimed to be useless for any commercial purposes. He contended that his wireless telegraphy apparatus was not an infringement of the plaintiff's, which contention was sustained by the court.

## BY THE WAY.

A LONDON fog is an expensive visitation. A day of it, counting the day at eight hours, is estimated to cost anything from £50,000 to £100,000 in hard cash. No small proportion of this goes to the gas and electric light companies, which have to supply about a third more power than usual. But there are also the railways. Fog signalling is expensive. At Clapham Junction alone £50 has been spent by a single railway company during a day's fog in extra pay to the platelayers.

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WHEN the Atlantic cable service was first put in operation the rate charged was $1 per letter. This charge has now been reduced to one shilling per word. It can be easily understood that in those early days the use of the cable was only resorted to in extreme cases, and the greatest ingenuity was exercised to keep down the cost. In this connection a good story is told of the late Honorable Isaac Buchanan, of Hamilton, who wished to send a message in which the word Newfoundland occurred. After a good deal of hard thinking with the object of abbreviating this word and thus cutting down the cost of the message, the honorable gentleman decided to substitute for "Newfoundland" the word "dog." The message reached its destination, but the recipient was unable to interpret it, with the result that two or three additional messages were required before an understanding was reached, and the ultimate expense was many times in excess of what the original cost would have been if the more expensive word had been first employed.

## CANADIAN ELECTRICAL ASSOCIATION.

The various committees which have in hand the arrangements for the annual convention of the Canadian Electrical Association to be held in Ottawa in June, are working enthusiastically for the success of the meeting. A series of interesting papers has been promised, and other features of an interesting and instructive programme are rapidly taking definite form. The local committee of arrangements includes representatives of all the electrical companies in Ottawa and vicinity, besides a number of citizens prominently connected with other enterprises. Having the benefit of the experience of the gentlemen who so successfully arranged the Ottawa convention of five or six years ago, there is sufficient assurance that nothing will be left undone which would ensure a pleasant and profitable meeting. Persons connected with the electrical industry who may not yet have connected themselves with the Association should send in their applications to the Secretary, C. H. Mortimer, Confederation Life Building, Toronto, or to any officer or member of the Association.

## MUNICIPAL OWNERSHIP.

In the course of an address delivered at the annual convention of the Northwestern Electrical Association, held at Milwaukee on January 16th, the president, Mr. P. Norcross, expressed the opinion that as municipal ownership becomes more fully understood the desire for it will diminish. Many interesting facts, he said, were contained in a report made by a committee appointed by the National Association of Officials of Bureaus of Labor Satistics in the United States. In one municipal plant there were eight private arc lamps of 1,200 candle and ten street lamps. The users of the eight private lamps were obliged to pay the city 12 cents per kilowatt-hour, while the city paid nothing for its ten street lamps. In other words, a few enterprising citizens paid for their own light five or six times as much as they would have paid to a private lighting company, and carried the entire burden of lighting the entire city's streets, which should have been borne by all of the taxpayers. In another plant the cost to the city of operating 75 street lamps was over 12½ cents per kilowatt-hour. In contrast to this a private company was mentioned which furnishes the city and private users light at the uniform rate of 2½ cents per kilowatt-hour.

## MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building,

MONTREAL, APRIL 5TH, 1901.

The Quebec Legislature have passed the bill incorporating the Montreal Light & Power Company, and having given some privileges hitherto unknown, naturally has raised public discussion here. If, however, the point is well looked into, the public have not much reason to kick. In regard to the streets, is it possible to make them any worse than they are at present? Will a few more poles, seeing what are up already, do any further harm or make the streets look any worse? Montreal has a good number of electrical workers idle, and this new work will provide situations; and as it is financed by men of excellent reputation and capable financiers, Montreal surely will not be the worse in the long run for their enterprise. Quebec looks to the government to put through any new schemes, but Montreal has to look to the enterprise of her own citizens, then why frown down their schemes when the whole cry heretofore has been, "Oh, for more enterprise?"

Citizens on the St. Catherine line of the Montreal Street Railway are so pleased with their new double-truck cars, that the "Windsorites" are jealous and longing for their turn. Now that the Chambly dam is prepared sufficiently for the railway to have some additional power, it is hoped the turn will come soon.

The dam having been sufficiently repaired at Chambly, power was turned on again last week, and the Royal Company were enabled to dispense with auxiliary plants at Montana street, Chenneville street, etc., which they had requsitioned into service at the time of the break. It is said that the Montreal Street Railway Company are now getting from that source 500 h. p., to be further increased shortly. This is, of course, in addition to their own power from steam power house on William street.

The new Montreal Light & Power Company are adding to the generator capacity at Chambly power house, the additions to be Westinghouse apparatus, and voltage now will be 20,000 stepped up by transformers and not taken directly off the generators, as was the case with the original S. K. C. generators, current from which was taken off at 10,000 volts. The step down station will be at the Royal Company, as before. This doubling up of voltage will, of course, give them greater carrying capacity on their lines, and it is evident that they intend selling electric current on an extended scale or certainly the expense would not be gone into. It also shows that they have got their present plant well loaded up.

The Lachine Rapids Hydraulic & Land Company seem to have stood off going into the combine, at least for the present. This still gives us a measure of competition in Montreal, and as has been said of the new U. S. steel trust, "sometimes the works with small output can hold the large ones to a price."

### NOTICE TO SUBSCRIBERS.

**Subscribers who may change their addresses on the 1st of May are requested to advise us of the fact, and send us promptly their new addresses, thus insuring correct delivery of their papers.**

The first legal step in the electric light trouble at St. Catharines, Ont., was taken a few days ago, when the old board of directors took out an injunction to prevent Mr. Nihan's board of directors from transacting any of the company's business.

# ELECTRIC RAILWAY DEPARTMENT.

## THE LANGEN SUSPENDED ELECTRIC RAILWAY.

An engineering work which has attracted much attention, and which differs from anything to be found in this country, is the Langen mono-rail suspended electric railway, operated between Barmen, Elberfeld, and Vohwinkle, near Colonge, in Germany. The system consists essentially in the employment of a single rail fixed to the under surface of a viaduct, which latter is supported by light lattice work construction. As shown by the illustrations, the wheels roll above instead of beneath the cars. The machinery which we are accustomed to see beneath an electric car is located upon the top, and a remarkable fact is that the wheels roll along a single rail instead of two. One rail railways have been constructed before, but the cars have always been above and kept from falling over or leaving the rail by wooden or metal beams which formed a cradle or channel through which they ran. On the Barmen line the cars have no lateral supports whatever.

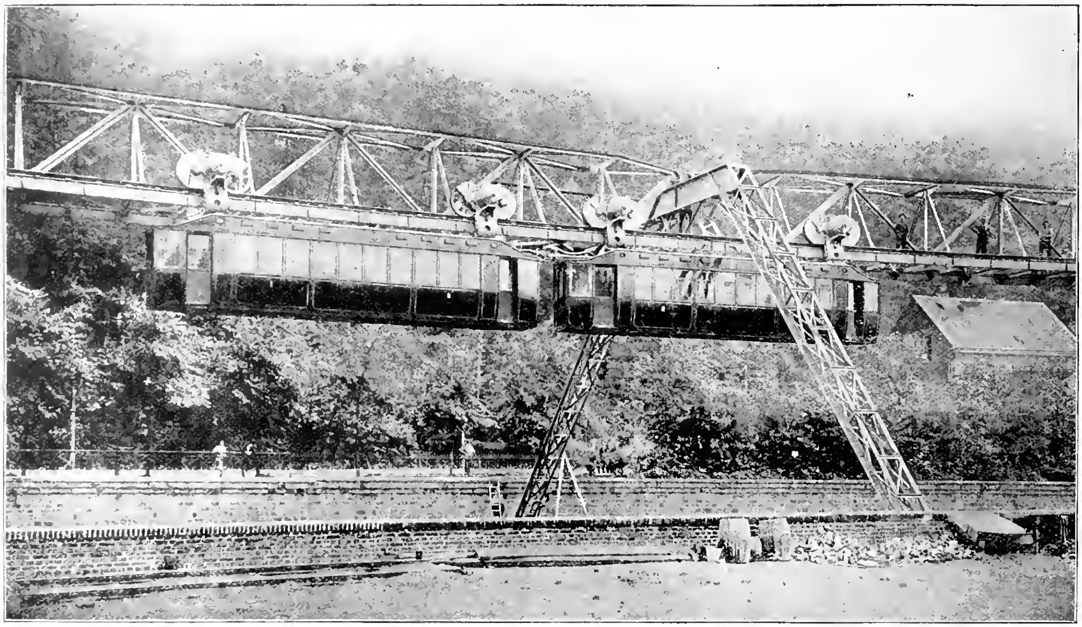

FIG. 1.- THE LANGEN SUSPENDED ELECTRIC RAILWAY.

The length of the road is eight and one-quarter miles. Six miles of the line pass over the Wupper river, a tributary of the Rhine, which varies in width from sixty-eight to one hundred and fifteen feet. No satisfactory route existed for a surface road, and it was deemed impracticable, on account of the expense and engineering difficulties, to construct an ordinary type of elevated railroad. The adoption of the hanging system was recommended by the engineers of the Electritats Aktiengellschaft, who estimate the total cost of the road to have been $2,500,000.

Steel castings, curved like huge hooks, are bolted to the upper frame-work of the car and connect it with the motor trucks on the rails. The centre of the car is balanced directly beneath the propelling wheels, which form the only support for the hook connections. The ties of the wheels are grooved or hollowed out to a depth of about an inch so that they grip the rail. The weight of the car acts as so much ballast in holding the wheels on the rails, and the grooves prevent them from slipping off, although to the observer it appears as if a car might break away from its fastenings and fall at any time.

To each truck are fastened two wheels one behind the other, the electric motor being placed outside and between the wheels. The electric current is carried through the motor by means of a trough or shoe which slides along a smaller rail charged from the power house. The motors are rated at 36 horse power at 500 volts. The currents supplied to the up and down track are separate, and a large storage battery is installed at the central station. In the case of a train of two or more cars the first car alone is fed directly by the current, a flexible cable of several wires supplying the necessary current to the other cars for motors, incandescent lamps or bells. Each car has a motor equipment. Westinghouse air brakes are used, the reservoirs being refilled at the terminal points of the line.

Curves can be managed with but slight oscillations, in fact, curves with a radii of 50, 25 and 10 metres have been passed over with speeds of 41, 30 and 16 miles, deflecting the cars by 35, 36 and 27 degrees, and still no motion was felt by the passengers. The sharpest curve of the track proper has a radius of 295 feet. The cars are 37 feet long by 6.5 feet wide, and accommodate fifty passengers each. Two telephone wires are attached to the structure, and by means of a bamboo pole, carrying metal clips, connection can be made from any

car to the power house and various stations on the line Automatic ticket vending boxes are used.

The structure is about twenty-five feet above the street level, and the lowest portion of the car about 15 feet. The weight of the car, with its load of fifty passengers, is estimated at fourteen tons, made up as follows :

| | |
|---|---|
| Two electric motors with complete electrical outfit. | 6,743 lbs. |
| Two bogies with buffers and cross beams ......... | 3,960 " |
| Car body with seats complete ..................... | 12,903 " |
| Passengers ...................................... | 7,700 " |
| Total ........................................ | 31,306 lbs. |

The superstructure itself weighs 700 pounds per foot. The supports are placed at an average distance of 100

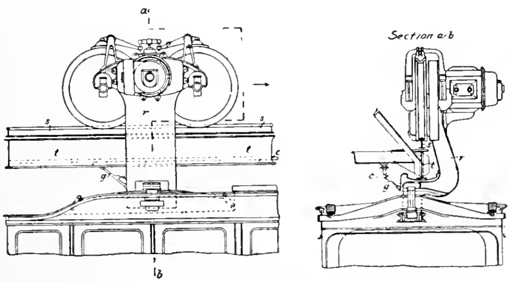


FIG. 2—DETAILS OF SUSPENSION TRUCK, LANGEN SUSPENDED RAILWAY.

feet apart. It is proposed to run the cars at a speed of thirty miles per hour, thus the average speed including stops will be about twenty miles. Trains of two cars run under a headway of two minutes, and are controlled by an automatic block signal system. It is estimated that with trains of four cars six thousand persons can be dispatched per hour in either direction.

The road was put in operation on October 24th, 1900, the work of construction occupying about two years. It is understood that some six thousand engineering drawings were prepared in connection with the installation.

## AMERICAN STREET RAILWAY ASSOCIATION.

The twentieth annual meeting of the American Street Railway Association will be held in the city of New York on October 9, 10 and 11. The Madison Square Garden has been leased for one week, and it is expected that the exhibit of street railway appliances will be on a very large scale. The Street Railway Accountants' Association of America will also convene, as usual, simultaneously with the Street Railway Association.

Among others, papers will be presented on the following subjects : "The Value of Storage Batteries as Auxiliaries to Power Plants" ; "The Public, the Operator and the Company" ; "The Best Manner and Mode of Conducting the Return Circuit to the Power House" ; "The Economies Resulting from the Use of Four Motors instead of Two on Double Motor Equipments" ; "Practical Results Obtained from Three-Phase Transmission and Rotary Transformers or Motor Generators in Transmitting Power on Railway Lines" ; "The Modern Power House, including the Use of Cooling Towers for Condensing Purposes."

Messrs. Pocock & Russell, of Hamilton, have invented a friction brake for steam and electric cars, by which it is claimed a car can be stopped within a very few feet when running at high speed. The principle is a friction shoe applied to the wheels of the car.

## SUNDAY CARS IN ST. JOHN, N. B.

An attempt by the Sabbath Observance Association of St. John, N. B., to prevent the running of street cars on Sunday, has failed, because of an adverse ruling by the police court. Complaint had been made against several motormen who were operating cars carrying passengers, and the street railway company moved for their dismissal on the ground that the street railway was exempt under the Sabbath Observance Act. Section 1 of this act provides that it shall not apply to persons carrying travelers, and the case turned on whether street railway passengers could be considered travelers within the meaning of the act. The principal difficulty was to determine the length of a Sabbath day's journey. The local authorities in matters ecclesiastical could give no assistance, but finally a case was found in the law books where a Sabbath day's journey was defined as 2,000 paces, or about three-quarters of a mile. Under this ruling the judge dismissed the complaints, holding the company's point as to passengers being travelers to be well taken.

## SPARKS.

It is announced that the Montreal Street Railway Company have acquired the Montreal Park & Island Railway, and that extensive improvements will be made to the road.

Conductors employed by the Brooklyn Rapid Transit Railway Company, of Brooklyn, N.Y., are now required to furnish bonds for $500 as a safeguard to the company against dishonesty. It is alleged that the shortage of fares among the 3,345 conductors employed in the various lines has in the past amounted to a large sum daily.

A recent Ottawa paper calls attention to the fact that the great value of the work done by Ottawa in electric railway enterprise related particularly to the snow problem confronting the Canadian cities between Kingston in the west and Quebec in the east. Prior to 1890 it was generally considered impracticable to operate wheeled cars upon tracks in the streets of Quebec, Montreal or Ottawa, which cities experience greater winter storms and depths of snow than any other cities upon this continent. The

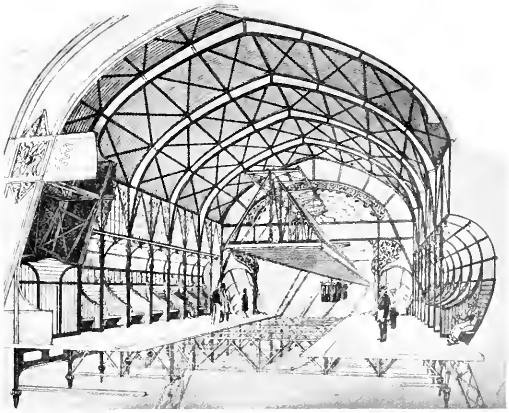

FIG. 3—INTERIOR VIEW OF STATION, LANGEN SUSPENDED RAILWAY.

manner in which Messrs. Ahearn & Soper overcome the obstacles was eagerly watched by the managers of the Montreal Street Railway Company, and as a result the example set by Ottawa was followed in Montreal. This debt of gratitude was gratefully acknowledged a few years ago in the Railway Committee of the House of Commons by the Hon. Mr. Brodeur, the present Speaker of the House of Commons, who stated that to the example and success achieved by Ahearn & Soper at Ottawa was due the fact that electric cars were adopted in Montreal. Mr. Brodeur spoke authoritatively, being for many years one of the solicitors for the Montreal Street Railway Co.

# ENGINEERING and MECHANICS

## INSUFFICENT BOILER CAPACITY.

In the discussion over the plans for abating the smoke nuisance in Chicago, an interesting contribution is made by an engineer, employed in a small plant, who describes the conditions which obtain in his boiler and engine room, and likewise, he declares, in a large majority of similar plants throughout the city. Reviewing the opinions expressed by several prominent local engineers, he says:

They one and all told you these three things--that bituminous coal on first exposure to intense heat gives off great volumes of black smoke, that our present appliances for its combustion are so imperfect that it is impossible to consume all this smoke, and that careful firing would do away with a large per cent. of it—and give the impression to the general public that, after all, the firemen are to blame for most of the trouble. Undoubtedly this is true in the plants presided over by these chief engineers, and probably it is also true in a number of the large down-town blocks and the large modern manufacturing plants, but if you want to get the true reasons for most of the smoke you complain of so constantly and bitterly, get out among the engineers and firemen who actually shovel the coal—the men who make the smoke—and then you'll get at the root of the matter.

He declares that the smoke nuisance is the result of inadequate boiler capacity and overworked engineers and firemen, and points to the files of the Society for the Prevention of Smoke for proof of this assertion. This society employed skilled men to visit and inspect steam plants and find out just why dense smoke was allowed to pour from the chimney, talk the matter over with the engineer and proprietor and suggest remedies. If they were unreasonable and refused to do anything the society intended to arrest and re-arrest them till they were glad to apply the remedies. They found instead that the smoke was mostly due to inadequate boiler capacity and overworked engineers and firemen and they had no remedy. If a boiler is not big enough to furnish the required steam without crowding the fire from morning till night there is no possible way to keep it from making a dense smoke. If a boiler with constant care and attention could possibly be made to produce the steam without undue smoke, in nine cases out of ten the engineer, who also does the firing, is required to do other work around the place, which prevents him from giving his fire proper attention. If a plant has a battery of, say, four boilers and really ought to have five or six, and employs only one fireman, as in plenty of places in Chicago, and this one man has to shovel from twelve to sixteen tons of coal under these boilers daily, take up and wheel out his ashes and look after his feed pumps, how would the "single shovel method" work?

Some of the examples cited are interesting and instructive. The public is asked for an expression of opinion on the following cases which are said to be typical of many in Chicago to-day:

What do you think of a 200-room hotel with only two boilers to run the heating system, elevators, laundry, etc., when the engineer does his own firing, wheels all coal from the front under the sidewalk to the rear, where the boilers are, is responsible for the hydraulic elevator pumps, feed pumps, laundry engines and machinery, and is expected to leave his engine room to go to any floor in the house to repair the heating system, electric lights, hydrant faucets, etc., any time he may be called on?

What do you think of a plant where the engine and boiler are in one corner of a 100-foot basement where the engineer is expected to keep up steam, run the engine, pumps, injectors, etc., all day, receive and put away all goods that are stored in the basement, keep accurate account of them, and give them out as called for, keep the floor swept and the whole basement clean and neat, have charge of and keep in repair the heating system of five floors, run two small machines eighty feet from the engine that have to be operated at least two-thirds of every day and do all the carpenter work for the building that can be done in the basement and then aken where it is to be set up and used?

Many engineers who have been questioned on this subject say hat the picture presented in the foregoing description is not overdrawn.—Modern Machinery.

Every steam plant should be fitted with more than one boiler eeder.

## SMOKE PREVENTION AND BOILER RATING.

The proceedings of the Engineers' Society of Western Pennsylvania, just issued, contains the recommendations of the committee on smoke prevention and boiler rating as follows:

In the matter of rating of steam producing plants, the following three divisions were discussed: (1) Heating surface per horse power; (2) great surface per horse power, and (3) amount of draft. The committee did not think it wise to recommend any fixed amount of heating surface per horse power, partly because some boilers are working economically with less than the usual surface usually recommended per horse power; that is, for a horizontal tubular 12 square feet, and for a water tubular 10 square feet.

In regard to the area of grate surface per horse power, the committee recommends the following; (1) Run of mine, one-sixth to one-fifth square foot per horse power; (2) slack, bituminous anthracite, one-fourth to one-fifth square foot per horse power, the air space in the grate being taken at 50 per cent. For mechanical stoking the rate should be the same.

Regarding the third matter the committee finds that in all cases the draft should be measured not in the stack nor in the ashpit, but in the furnace over the fire and with the furnace door closed and the ashpit door open when working the grate at the above mentioned rate. When thus measured in unfavorable weather the minimum should be three-eighths of an inch for run of mine and one-half inch for slack.

Regarding smoke prevention the committee reached the following conclusions:

1. In an ordinary furnace, smoke may be made very light by very careful hand firing, yet in practice this cannot be obtained continuously, and the use of special furnaces or appliances should be insisted on and made compulsory by law.

2. The best method of preventing smoke is to burn the fuel in a separate chamber, so that the combustion is complete before the gases touch the surface of the boiler.

3. Where this method is not practical, as in boilers already set and where there is no room, the best results are obtained by mixing the smoke, as it passes from the furnace with heated air, the effect of which increases the temperature of the smoke as the temperature of the air increases, thus burning the smoke.

4. That as, even with special furnaces of the above types, with hand firing, the combustion is irregular and hence some smoke must be produced at times, the use of mechanical stokers is strongly recommended, especially in all plants above 100 horse power.

5. As mentioned above, there is a lower limit of grate area per horse power below which the furnace is not heated enough to insure complete combustion and smoke is thus produced. For this reason all plants should be subdivided into two units at least, in order that the boilers may never run at a lower activity than one-third of their rated horse power.

## SAVING AND WASTE IN SMALL STEAM PLANTS.

An interesting case of improvement in the economy of a small power plant has recently come before our notice, says the Engineer, In the plant in question steam was required to heat a small building and to supply an engine developing some 20 to 30 indicated horse-power for about 10 hours per day. For this purpose two boilers were employed, one an old type heating boiler furnishing steam at low pressure for heating purposes, and the other an old and decrepit tubular boiler for the engine. A good grade of stove coal was burned in each costing about $5 per ton. Under these conditions the daily consumption of coal during the winter months was about one ton. In due course of time these old boilers were taken out and replaced by a modern boiler of the usual fire tube type. The grate of this boiler, both in extent and form of grate bar, was designed for rice coal instead of the more expensive fuel which had been previously used. At the same time the engine, which was simple and non-condensing, was arranged to deliver its exhaust into the steam heaters, and thus to utilize the exhaust steam for heating purposes instead of throwing it away entirely, and then providing by a separate boiler the steam reqired for the heating.

Under the same general conditions as before and without further

engineering refinement, the consumption of fuel has been reduced to about one-half ton of rice coal as compared with the ton of stove coal formerly used. This means a net saving of about $4 per day in the fuel account. During the summer months the saving will be less, but it is within the limits of probability to count on a saving of about $1,000 per year simply in the fuel account.

With some further improvements, such as an exhaust feed water heater, improved non-conducting covering for the boiler and piping, a still further saving may be expected.

It may, of course, be said that the first conditions were excessively wasteful, and such indeed was the case. At the same time there are only too many just such wasteful little steam plants scattered throughout the length and breadth of our land, and while in many of them conditions would not permit of so large a relative financial saving as that described above, still the illustration given may be taken as a fair example of what may be saved under conditions of this general character. Again it may be noted that the new plant referred to is by no means in the front rank of engineering practice. The installations, old and new, in fact involve only the simplest of every day engineering, and may be taken as a good illustration on the way money may be wasted or saved in the fuel account of an ordinary small steam and power plant.

## HINTS FOR ENGINEERS.

An asbestos plug cock makes a very good blow-off cock. Engineers used to argue concerning the advisability of turning the plugs of these cocks more than one-quarter revolution, but such discussions were suddenly cut off by the appearance of plugs that could not be turned more than 90 degrees.

Many of the valves found in modern steam plants have removable discs, so that when one leaks it can easily be repaired. A supply of these discs should always be kept on hand, as it may not be convenient to buy one when it is wanted.

When an engine runs "under," it always has an awkward appearance.

If you are not paid as much money for running your engine as you consider the job worth, do not fail to keep the plant in first-class condition, for visitors will not stop to inquire how much salary you receive.

When calculating the speed of an engine, begin with the governor pulley, just as it it were the driving pulley on a shaft.

If it is necessary to use the common globe check valves, when piping up a steam plant, use one size larger than the pipe, as they will work with less friction.

Leaky boiler seams should never be calked with steam pressure on the boiler.

One hundred pounds of wood are equal to forty pounds of good coal, so far as steam-making qualities are concerned. A cord of hickory wood is worth much more than a cord of chestnut, but the latter does not weigh as much as the former, so that for equal weights, there value is equal. It is assumed that the wood is thoroughly seasoned.

Before you attempt to carry your indicator box away by the handle, be sure that the lid is locked or hooked, as otherwise you may find the indicator on the floor.

An injector requires steam for its successful operation; hot water will not answer the purpose.

Ground joints on cylinder heads of steam engines are good things, as they save packing and trouble, but they must be used carefully when taken apart, as it does not require much to make them leak. Before they are put together both surfaces should be well cleaned, and treated with cylinder oil.

Locate the blow-off valve as near your boiler as possible.

Plumbers often use wax for making joints on gas pipes, in order to prevent leaks, but red or white lead will do for ordinary work; if there are small leaks the joints may be varnished.

When fitting up a water tank for use in the upper story, or perhaps on the roof, locate the outlet pipe in the side near the bottom. Do not let it project on the inside, but have it funnel-shaped, with the inner end flush with the inside of tank. That is the way to secure the greatest efficiency; in other words, the proper way to get the most water through the pipe in a given time.

When an engineer thoroughly understands the machine that he has charge of he has made a good point, but he can not claim to be well informed in the business until he has a good working knowledge of several other kinds. He should also study up the man who owns the machine he is running, for failure to do this may result in complete dissatisfaction, when he in reality is a competent engineer.

When it is desired to connect into a pipe say 2 inches or less in diameter, it is frequently cheaper to break a cast iron L than to disconnect several joints.

If you intend to use a heavy cylinder oil in a cold place, buy a downward-drop lubricator.

Be sure to close the drip cocks on your engine when it has attained full speed.

The tensile strength of a rivet is usually much greater than its shearing strength, but this is counterbalanced by the fact that when two boiler plates are riveted together, the friction which must be overcome before they can be torn apart, is very great.

Do not roll sheet packing into a bundle of small diameter, but spread it on a broad shelf.

Some pumps have hand levers to start them with in case the valve gear fails to work, while others have none because it is claimed that none is needed. I prefer the former.

It is a good plan to let your engine exhaust into your heating system, but it is not necessary or advisable to have the inner surface of the pipes coated with the dregs of cylinder oil. It is well to put a separator in the exhaust pipe and locate it near the engine.

Do not do anything to discourage yourself. This means that if you are an engineer, striving to keep and old plant in good order, do not count the hours you work each week (unless you are fortunate enough to be paid by the hour), for they may mount up to an alarming figure and so operate to dishearten you.

Heating by direct radiation means that the radiators are located directly in the rooms to be heated.

Rosin makes a very poor belt dressing.

Do not attempt to tighten the nuts on a flange coupling under steam pressure.

What a great number of reasons are given for boiler explosions as we hear of them from day to day! If all were correct it would prove a steam boiler to be a very complicated and unsafe thing to handle, or work around, but fortunately some of these reasons do not exist outside of the fertile brain of those who exploit them for their own benefit. A boiler explodes because it is not strong enough to stand the pressure that is put upon it, and that covers the whole ground. The boiler may be new, with defects that render it at once unsafe, and when working pressure is put upon it there is trouble, or it may be old and gradually grow weaker until it fails under an ordinary pressure. Of course, it takes an experienced engineer to tell when it has become unsafe, but there is nothing supernatural about it, as some people would have us believe.—H. W. Wakeman, in The Wood-Worker.

## DUPLEX TELEPHONE LINE IN JAPAN.

Some time ago the Japanese government caused to be installed two metallic-circuit telephone toll lines between Yokohama and Tokio, a distance of about 15 miles. The traffic soon exceeded the capacity of these lines, and in default of a government appropriation for a third line, it was decided to duplex the two existing ones. To do this the repeating coil at each end of either circuit (four in all) was split at the middle point of its primary winding, and a wire placed connecting these two points in the two coils at Yokohama, and a similar connection between the two coils at Tokio. In each of these cross-connecting circuits was placed the ordinary microphone and telephone apparatus. Thus a third circuit was obtained, the two legs of which were double, each leg embracing the two parallel wires of one existing metallic circuit. Interference and cross-talk between the new instruments and the others was thus neutralized in each circuit. The duplex arrangement has been working satisfactorily since its installation.

A great telegraph case is before the Court of Appeals in Toronto. The plaintiff is George Morrow, a Boston broker, and he is suing to set aside a transfer of stock in the Montreal Telegraph Company to the Great Northwestern Telegraph Company, whereby the Western Union Telegraph Company secured control of both companies. He failed before the lower court. It is said that $20,000,000 of securities are directly and vitally involved in the result of the action and appeal. It is claimed, incidentally, by the plaintiff that the Great Northwestern Company is not earning the eight per cent. dividend it pays annually to the Montreal Telegraph shareholders, and that the Western Union is making up the deficit and charging it against the Canadian companies.

## SPARKS.

Hugh McColl, electrical contractor, of Ottawa, is announced to have assigned.

An agitation is on foot to have the streets of the village of Embro, Ont., lighted by electricity.

Mr. John Ganter has been appointed engineer of the waterworks and electric light plants at Woodstock, N. B.

Mr. Simmons, electrician of the electric light plant at Huntsville, Ont., has tendered his resignation to the council.

The electric light plant of the Fraserville Company at Riviere du Loup, Que., was destroyed by fire early last month.

The ratepayers of Dresden, Ont., have voted in favor of borrowing $10,000 on debentures to purchase an electric light plant.

The Guelph Street Railway Company has secured a charter for an electric road to Hespeler, via Puslinch lake, and to Berlin.

Hull Bros. & Company are building a large block at Calgary, N. W. T., and purpose installing an electric light plant in the building.

A by-law will be submitted to the ratepayers of Lindsay, Ont., at an early date to provide for installing a municipal electric light plant.

It is reported that work will be commenced in the spring on the extension of the Hamilton Radial Railway from Burlington to Oakville.

The town of Yarmouth, N. S., is seeking authority from the provincial legislature to borrow $10,000 for the purposes of electric lighting.

The city council of Victoria, B. C., have recently purchased some arc lamps for street lighting from the Gregory Electric Company, of Chicago.

Messrs. Breck & Halliday have secured the contract for wiring the new drill hall at Kingston, Ont., for 185 incandescent and 8 enclosed arc lamps.

Mr. Roderick J. Parke, electrical engineer, recently gave before the Engineers Club, of Toronto, an interesting talk on "The Application of Electrical Power to Manufacturing Purposes."

The Nelson Tribune says that an electric power and lighting plant of a capacity of 1,000 h.p. is to be erected at Three Forks, Slocan, B.C., by Mr. J. M. Harris, a principal owner of the Reeco mine, Sandon.

It is said that the village of Glace Bay, in Cape Breton, will install an electric light plant during the coming summer. It is also understood that an electric railway between Glace Bay and Sydney is mooted.

The Amherstburg Electic Light, Heat & Power Company have re-elected the following officers: N. A. Coste, president; John A. Auld, vice-president; W. H. McEvoy, managing director; F. M. Falls, secretary treasurer.

The demand for office accommodation in the vicinity of the recent great fire in Montreal has induced the Great North-Western Telegraph Company to fit up for office renting purposes the top storeys of their building.

Mr. J. Beck lost his life recently in the works of the Canadian General Electric Company at Peterborough, Ont. While interested in his work he unthinkingly lowered his head, which was caught between two pieces of iron which came together, causing almost instant death.

Tenders have just been taken for the erection of a boiler house and for the steam heating and electric power plant for a central heating system for Queen's University at Kingston, Ont. The architects of the work are Messrs. Symons & Rae, 15 Toronto street, Toronto.

The Peterborough Hydraulic Power Company has been incorporated, with a capital of $50,000 and head office at Peterborough, Ont., the object being to develop a water power. Hon. George A. Cox, of Toronto, and Mr. W. G. Morrow, of Peterborough, are among the promoters.

The town of Digby, N. S., may ask authority from the Legislature to borrow $40,000 for the purpose of buying out the electric light plants at Bear River and Digby, and using the present water power of the Bear River Company to supply the above named towns with electric light and power.

Mr. Harold Fraser, the new manager of the electric light plant at Brockville, Ont., made a verbal report to the commissioners a few weeks ago, in which he recommended the installation of new generators for power, arc and incandescent purposes, and the purchase of new wire, poles, insulators, etc. He estimates the cost of the proposed improvements at $2,500.

Mr. W. E. Stevens, barrister, of Aylmer, Ont., has made application to the Ontario Legislature for the incorporation of the London, Aylmer and Port Burwell Electric Railway Company, to construct an electric railway connecting the points named, passing through the counties of Middlesex and Essex.

The New York Journal makes the announcement that Edison has invented a storage battery which will be able to produce power so cheaply that coal will be worth little more than sand. It is stated that he has been working on the battery for years, and expects to have it in commercial shape by next fall.

The Electric Lighting Company at Portage la Prairie, Man., are negotiating with the corporation for a renewal of their lighting contract. The council is willing to pay $1,600 for the present lighting service for one year, while if a contract for a longer period is given a number of improvements to the plant are demanded by the town.

The village of Carleton, a suburb of St. John, N. B., has been lighted electrically by D. W. Clark & Sons, who have in addition supplied houses and stores in Carleton and Lancaster. The ctiy now proposes to acquire the franchise of this firm and will likely purchase their plant. The project of building an electric railway in Caleton may also be taken up by the city.

Mr. T. A. Stephen, on behalf of a company, has applied to the town of Edmonton, N. W. T., for the charter of the Edmonton Street Railway Company, now held by the town. This charter was obtained in 1894 and was for a street railway, with power to build from Strathcona to Edmonton. The intention of the present company is to apply for an extension of the charter so as to take in the municipalities within a radius of 25 miles of the town.

The Canadian General Electric Company have purchased a a tract of 30 acres of land at the crossing of the Northern and C.P.R. railway lines, Toronto, on which it is the intention to erect an extensive foundry. The first building to be erected will be a large general foundry, to be followed by a pipe foundry, machine shops, structural iron shops, blacksmith's shop, power house, store house, etc. Railway tracks will be run through each building, and electric cranes will be provided for handling work up to 50 tons. All the machinery in the shops will be operated by electric motors. The equipment will be of the most modern character, as representatives of the company have recently visited the leading manufacturing centres in the United States acquiring information as to the latest and best methods of shop construction. It is expected that the work of construction will begin in the early summer.

## MOONLIGHT SCHEDULE FOR MAY.

| Day of Month. | Light. | Extinguish. | No. of. Hours |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | 2.15 | 4.15 | 2.00 |
| 2 ... | No Light. | No Light. | .... |
| 3.... | " | " | .... |
| 4.... | " | " | .... |
| 5.... | P.M. 7.30 | P.M. 10.30 | 3.00 |
| 6.... | " 7.30 | " 11.15 | 3.45 |
| 7.... | " 7.30 | " 11 50 | 4.20 |
| 8. .. | " 7.30 | " 0.30 | 5.00 |
| 9.... | " 7.30 | " 1.30 | 6.00 |
| 10.... | " 7.30 | " 2.00 | 6.30 |
| 11.... | " 7.30 | A.M. 2.30 | 7.00 |
| 12.... | " 7.45 | " 3.00 | 7.15 |
| 13.... | " 7.45 | " 3.45 | 8.00 |
| 14.... | " 7.45 | " 4.45 | 8.00 |
| 15.... | " 7.45 | " 3.45 | 8.00 |
| 16.... | " 7.45 | " 3.45 | 8.00 |
| 17 ... | " 7.45 | " 3.45 | 8.00 |
| 18.... | " 7.45 | " 3.45 | 8.00 |
| 19.... | " 7.45 | " 3.45 | 8.00 |
| 20.... | " 7.45 | " 3.45 | 8.00 |
| 21.... | " 7.45 | " 3.45 | 8.00 |
| 22.... | " 10.00 | " 3.45 | 5.45 |
| 23.... | " 10.30 | " 3.45 | 5.15 |
| 24.... | " 11.00 | " 3.45 | 4.45 |
| 25.... | " 11.30 | " 3.45 | 4.15 |
| 26.... | " 11.50 | " 3.30 | 3.40 |
| 28.... | " 0.10 | " 3.30 | 3.20 |
| 29.... | A.M. 0.45 | " 3.30 | 2.45 |
| 30.... | " 1.15 | " 3.30 | 2.15 |
| 31.... | No Light. | No Light. | .... |
| | | Total............ | 148.50 |

## A METHOD OF CHARGING FOR ELECTRICITY.

At a meeting of the North-Western Electrical Association held January 16th at Milwaukee, a paper suggesting a method of charging for electric service was read by Henry L. Doherty, an abstract of which is herewith presented.

There are but two distinct ways of charging for electric service: First, flat rates; second, meter rates. Abstractly, flat rates are preferable, being an advantage to the station if properly imposed rates are given, but even then such rates are liable to drive away much profitable business. Meter rates cannot be placed so high but that loss may result, as a consumer's costs to the company will not equal his total payment, even if he pay $1 per kilowatt. The inequity of flat rates need no comment. Payment based on meters is often more inequitable than flat rate basis, because of difficulty of not knowing the maximum demand that the station must be prepared to supply. Charging a fixed rate per kilowatt-hour on meter basis bears no relation to cost of service. Cases may sometimes be best illustrated by exaggerations. Suppose you should receive an application for a 2,000-light connection to be used as a relay in case of a break-down of an isolated plant. At what rate per kilowatt could you afford to supply the applicant with current? This is the same problem which confronts us on a modified scale with each consumer.

Our costs are fixed by:

1. The number of consumers we have.
2. Distance from the station.
3. Capacity they demand.
4. Amount of their consumption.

The proposed system is stated as follows: There are costs such as bill making, and meter reading, which are fixed by the number of consumers or meters, and many other costs that are fixed by the number of consumers or meters we must care for, such as meter testing and maintenance, office rent, complaints and gratuitous work, superintendence and inspection. To cover such expenses, I propose to have a fixed charge for each consumer, regardless of his consumption or the size of his installation, provided no more than one meter is installed. There are certain other costs which are fixed by the capacity demanded, such as interest on investment, transformer losses, maintenance, depreciation, etc. To cover such expenses I propose to have a fixed charge for each lamp the consumer's connection will permit him to demand, without regard to the number of lamps installed or amount of current used. There are other charges which are fixed by the quantity of current generated, such as boiler fuel, lamp renewals, etc. To cover such expenses as these, I propose to charge a fixed and uniform rate per kilowatt-hour consumed. Outside of boiler fuel and lamp renewals, your operating costs would not be greatly increased if you operated twenty-four hours per day at your maximum load, nor would they be greatly diminished if you operated but five minutes per day, at your maximum load, assuming, of course, that you stood ready to serve current at any time throughout the twenty-four hours should it be called for. A charge for "readiness to serve" fixed on this basis and a low kilowatt-hour rate will bring about many advantages to the central stations, and protect them from loss, unprofitable patronage, and, I believe, will protect them from undesirable legislation. Any change in methods of charging will cause trouble, if enforced suddenly on those consumers whose bills it will increase, but this system can be used in place of horizontal reductions in the rate now charged, and can be reasonably exacted from new consumers, and eventually made universal. Evolution, not revolution, must be the policy of all quasi-public corporations. In view of the fact that it will be inadvisable to enforce this system on old consumers, who will be injured by its adoption, I propose to adopt it first as a substitute for all special rate consumers, and also for non-consumers. Instead of dividing my expenses as they exist to-day and apportioning them amongst the consumers on this basis, I expect to adopt such charges as will benefit long-hour, and therefore profitable consumers, to such an extent as can be readily compensated for by the additional business which can be secured with a lower rate per kilowatt-hour. I will continue the rate cutting by small steps, so long as I can protect the company's net earnings from marked shrinkage.

In one station, where we have been experimenting, we are convinced that it is more profitable to supply consumers on this rate system, making a fixed charge of $6 per consumer per year, plus $1.80 per lamp demanded per year, to which is added 4 cents per kilowatt-hour, for current used, than to sell at a straight rate of ten cents per kilowatt-hour. Consumers will be more liberal in the use of current when supplied at 4 cents than at 10 cents per kilowatt-hour. My plan is to make all contracts for a year or more, allowing the consumer to contract for any capacity he may choose; the capacity to be increased whenever he desires, but not to be decreased except at the expiration of the period contracted for; the capacity to be limited by a suitable maximum demand cut out to prevent him demanding more capacity than he contracts and pays for, and one-twelfth of the fixed charge to be included in each monthly bill. This system, I believe, can be rendered absolutely uniform, both for light and power, and will prove more equitable than any other system. A reduction of the kilowatt rate should be made for current supplied for power purposes, to compensate for higher costs for lighting service, owing to the exact degree of regulation necessary, and the cost of lamp renewals, which is a more important item than is generally believed. This system is free to be used as described, or can be modified to suit. It is in use in one central station and has been partially adopted in two other central stations.

## ILLUMINATING POWER OF ACETYLENE GAS.

Recent experiments have shown, says the Electrical World, that the illuminating power of acetylene gas after being stored five months in a gas holder over water was only 6 per cent. of that obtained under corresponding conditions with freshly prepared gas, although the color spectrum was approximately the same. In other words, acetylene gas will not keep its illuminating power. Moreover, the illuminating power of this gas is shown to vary with the manner in which the gas is obtained from the same materials of calcium carbide and water. The gas obtained by the "dry process" had only about 80 per cent. of the illuminating power of gas obtained by the "wet process." This shows that if water is added to calcium carbide the effective result is not the same as when calcium carbide is added to water.

## IMPROVEMENTS IN THE COLOR OF THE ARC.

Many attempts have been made to improve the violet-blue color of the arc light, which is objected to as much as ever, and, if possible, at the same time to increase the light capacity of the lamp. According to a paper read by W. Wedding before the Union of German Electricians, held this year at Kiel, a considerable amount of success has after all been achieved by H. Bremer, of Neheim, on the Ruhr river, says Engineering. The carbons, that is, only the upper electrodes, are impregnated with salts of calcium, silicon and magnesia, up to 50 per cent. of such salts being added to the carbon. Calcium appears to be the chief ingredient. The reddish yellow flame of calcium softens the tone of the light, which the inventor claims can be varied at will. The calcium oxide coats the inside of the globe, and of the chimney which is used in some lamps, with a white deposit, which helps to diffuse the light in all directions ; so that we do not see a glaring point, with unsteady, ugly shadow lines on the upper half of the globe and a zone of comparative darkness directly under the lamp, but a pretty uniformly bright globe.

The photometer tests which form the chief part of Wedding's paper, illustrate these and other features. With an arc lamp taking 12.3 amperes at 44.5 volts, Wedding observed that the light intensity was almost constant ; over 6,000 candles, in the cone between 45 degrees and 90 degrees with the horizontal, and that on the horizontal itself the intensity was still 1,000 candles. The hemispherical intensity was 4,320 candles, which corresponds to a mean current consumption of 0.126 watt per candle. This a very remarkably low value. The lamp was without a globe ; with a globe the current consumption was 0.196 watt. The carbons are vertically arranged, not quite in alignment. The mechanism is said to be much simplified, but no real information was offered on this point, beyond stating the fact that the arc is considerably flattened out and contributes materially to the light emission. The yellow nature of the light should assist these lamps in penetrating through mists. Some preliminary experiments support this view, but the subject requires further investigation. As regards searchlights and light-house lamps, where this penetrating power would be of paramount importance, the large arc may prove awkward ; for these lamps we want a fairly punctiform source of light. A Bremer arc lamp with four arcs has been suspended at a height of 95 metres (312 feet) from the Eiffel Tower in the Paris Exhibition. The four acres were arranged in two series, and took together 55.8 amperes at 89.3 volts. Tested without a globe, when suspended 8 metres (26 feet) above the ground, light intensities of 80,000 candles resulted, the mean current consumption being 0.1 watt per candle, based upon a hemispherical intensity of 49,730 candles ; the maximum light intensity was observed under an angle with the horizontal of 37 degrees. Fitted with a globe, the hemispherical intensity was 26,890 candles, corresponding to a current consumption of 0.17 watt. The metallic vapors in the arc diminished the resistance of the arc, but the carbons burn away twice as rapidly as ordinary carbons. If, however, the ratio of the carbon section, new to old, is 1.3, as is asserted, that disadvantage would balance itself. No vapors are supposed to escape from the globe. Bremer uses his carbons also with alternating-current arc lamps.

## A DETERMINATION OF THE MECHANICAL EQUIVALENT OF HEAT.*

BY DR. HOWARD TURNER BARNES.*

The method employed is that proposed three years ago by Prof. Callendar and the author at the British Association meeting at Toronto. In essence it consists in warming by a steady, measured supply of electrical energy, the volume of water passing at a constant determinate rate through a short small-bore glass tube containing the current-conveying wire. The small-bore tube connects two larger tubes in which are fixed the two members of a pair of differential platinum thermometers. These thermometers are used, when everything has become steady, to measure the difference between the temperatures of the water entering and leaving the middle small tube.

A glass vacuum jacket, itself surrounded by a copper jacket containing water at the inflow temperature, embraces this middle tube ; and thus the heat lost by radiation from the water as it is warmed in and flows from the tube is reduced to a small yet measurable amount. Errors in the final results arising from this loss of heat by radiation, from the loss of heat by conduction, from the tendency of the water to follow unvarying stream-lines, and from the thermal capacity of the apparatus, with others of smaller import, were all estimated and allowed for. The most important of the measurements involved are the electrical ; and the accuracy of these depends ultimately upon the accuracy of an international standard resistance and upon that of the voltage assigned to a Clark cell. The Clark cells employed in the present series of experiments gave values agreeing with all the best results obtained in setting up this electro-chemical combination.

The results of the experiments, which extended over a year, are given in 55 tables. From these the author constructs another table of the values of the specific heat of water at temperatures between 0° C. and 100 C. differing by 5° C. In terms of a thermal unit at 16°C. the specific heat at 5°C. is 1·00530, at 40°C. is 0·99735, and at 95 C. is 1·00370. It is a minimum at 37·5 C. In terms of the thermal unit at 16°C. the mechanical equivalent is 4·18876 joules—about 0·132 per cent. higher than that obtained by Reynolds and Moorby in their direct mechanical method. This discrepancy is due, the author concludes, to the fact that the E.M.F. of this standard Clark cell should be taken as 1·43325 int. volts, and not as 1·43420 volts, as used in his calculations. With this new value for the E.M.F. of the Clark cell, the author's results come into most excellent accord with those obtained by Prof. Rowland. The author, however, ascribes the slight differences still existing between his results and the results obtained by the electrical methods of Griffiths and of Schuster and Gannon to the radical difference in the methods of calorimetry.

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Engineers are much more willing to help each other than they were twenty years ago. Much of the credit for this desirable state of affairs is due to the engineer's associations that may be found in nearly every state in the Union. This is a move all along the line in the right direction, for the more we help our brother engineers the better posted we become, for a principle that was laid down several hundred years ago tells us that when we improve our talents they will multiply.

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* Abstract of a paper, "On the Capacity for Heat and Water between the Freezing and Boiling Points, together with a Determination of the Mechanical Equivalent of Heat in Terms of the International Electrical Units," read before the Royal Society, being an account of experiments by the continuous-flow method of calorimetry, performed in the Macdonald Physical Laboratory of McGill University, Montreal.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

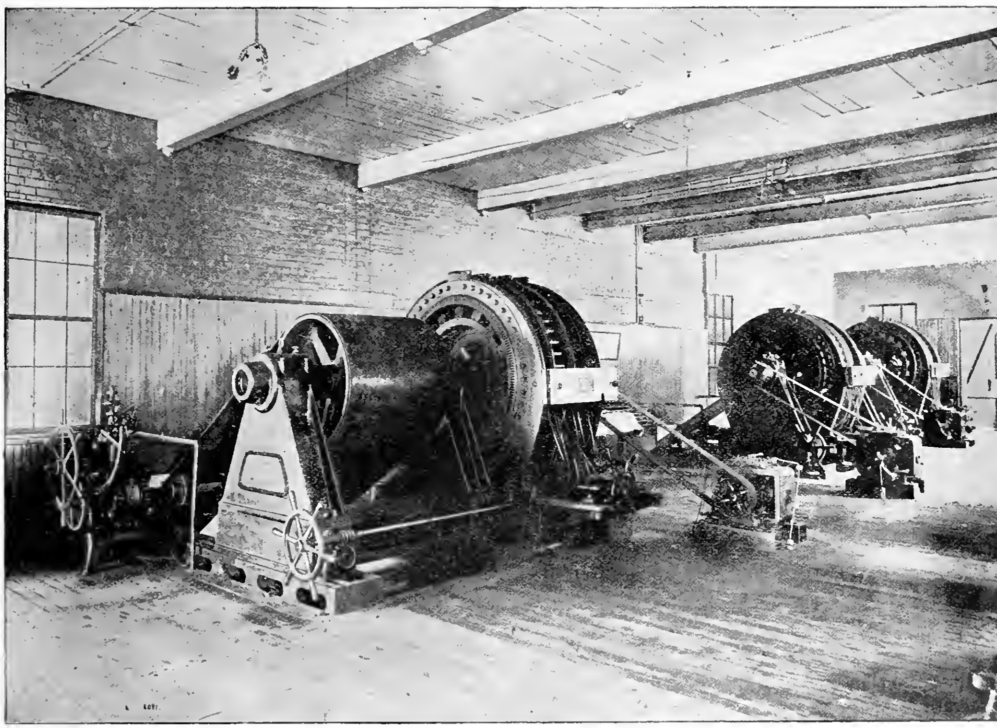
VOL. XI. MAY, 1901 No 5.

## A MODERN LIGHTING AND POWER PLANT.

ONE of the most modern and well cared for electric plants in the country is that operating in the city of Sherbrooke, province of Quebec. Twelve years ago the Sherbrooke Gas & Water Company started to light the streets, using for that purpose two Ball arc dynamos having a capacity of 35 lights each, supplying current for 52 arc lamps of 2,000 candle power. During the same year a 500 light T.H. Royal alternator was installed in order to supply incandescent lamps.

From this modest beginning has developed the present plant, having a capacity of 840 kilowatts. The phenomenal success of this plant has been due in large measure, to the able engineering of its superintendent, Mr. A. Sangster, to a broad policy of dealing with customers, and keeping the equipment always up-to-date.

The power-house is substantially built of brick, and and is situated on a rocky island in the Magog river near the center of the city. Here the natural fall of the river has been utilized to the utmost, and a magnificent water power developed having a working head of 33 feet. The dam is largely composed of the natural bed rock supplemented by massive crib-work where necessary. The construction of the head-race is such that this plant has never suffered any inconvenience from frazil or anchor ice, the bane of most water-wheel plants in this section of the country.



INTERIOR OF GENERATING STATION, SHERBROOKE GAS, WATER & ELECTRIC COMPANY.

The location of power house and dam allows of strong, short steel flumes being used, one for each wheel. The hydraulic equipment consists of three units, each belted direct to a two-phase S.K.C. alternator, having an aggregate capacity of 1,000 horse-power. The wheels are supplied with governors of the Ripogle type, made by Wm. Kennedy & Sons, of Owen Sound, and have proved very satisfactory. There are two 40 inch Crocker horizontal turbines supplied by the Jenckes Machine Company, of Sherbrooke, and one 54 inch New American made by Wm. Kennedy & Sons. Each

is supplied with a pulley carrying a 38 inch belt driving the generators on the floor above.

The generators are of the well known S.K.C. type, as manufactured by the Canadian General Electric Company, Toronto. Generating two-phase current of 133 periods frequency at 2,400 volts. One is of 300 kilowatt capacity, the other two are each of 240 Kilowatts capacity.

Each generator has belted to it a multi-polar exciter, each capable of supplying sufficient current to excite all of the generators.

A handsome marble switchboard extends across the end of the power house, supplied with S. K. C. switches and instruments, as manufactured by the Canadian General Electric Company. The switchboard is supplied with independent phase regulators for each generator, and connections are so made that any of the generators may be operated in parallel or on separate circuits, as desired. To the left of the main switchboard is situated the board for the series alternating enclosed arc lamp system now used for lighting the streets. This system, which has met with such phenomenal success in both the United States and Canada, was installed about two years ago by the Canadian General Electric Company, and consists of two fifty light circuits, each supplied with an automatic regulating transformer. Although severely tested, this system has proved satisfactory in every way. At times it has been found necessary to cut off 14 lamps from one circuit, and the regulation is so perfect that no difference is noticeable on the remaining lamps or on the incandescent circuits which operate in parallel.

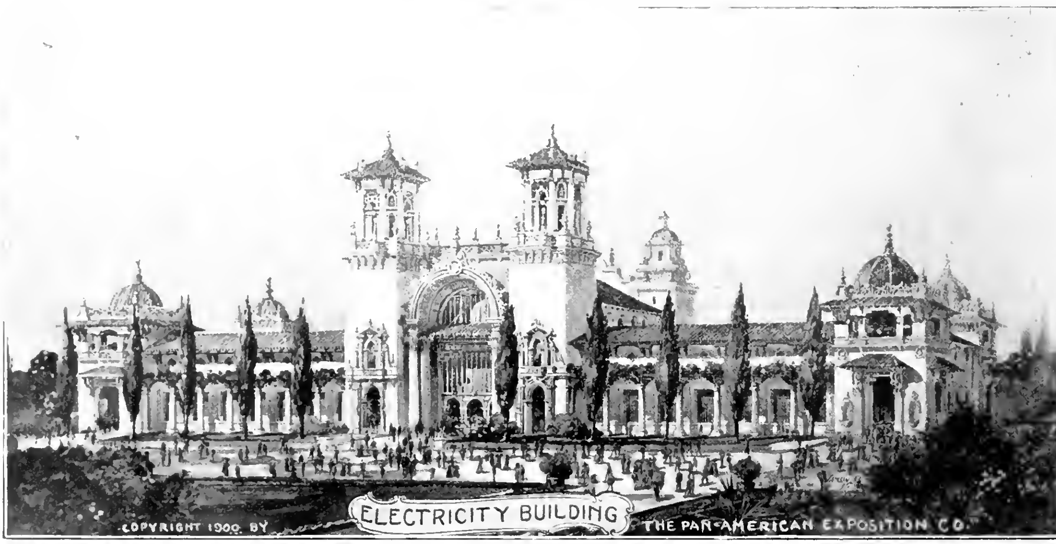
The citizens of Sherbrooke have shown their appreciation of good electric service not only in the liberal use of lights, but also of electric current for power purposes, as there are now installed 23 S.K.C. two-phase motors ranging from one to 30 horse power capacity and aggregating a total of 240 horse power. The motors are all of the S.K.C. design and are supplied with condensers. Practically all of the current consumed is measured by Stanley watt-meters, there being upwards of 300 installed.

The neighboring town of Lennoxville, distant seven miles, is also supplied with light and power from this system. Although the service rendered by this plant is extremely varied, and the motive power is water, yet such great care has been taken to obtain and maintain efficient regulating apparatus for wheels, generators, motors and arc lamps, that the operation of the system is practically automatic and no fluctuations of voltage are noticed even at noon, when motors are stopped and the lighting load is small.

The superintendent, Mr. A. Sangster, has a snug office at the power house, where is also fitted up a small repair shop and stock room for wiring supplies and handling of the arc lamps.

The head office of the company is situated in the Art Building, in the centre of the city; it is presided over by Mr. R. S. Robins, the genial secretary-treasurer, who is always glad to see visitors and talk over the accountant's end of the business, while many pointers on operating can be obtained from the long and varied experience of our friend, Mr. Sangster.

Taken as a whole, this plant is a striking example of what can be done in developing an efficient multiphase electric distribution from small beginnings, where good sound business methods are followed.




PAN-AMERICAN EXHIBITION ELECTRICITY BUILDING.

## STEAM ECONOMY.

The American Machinist of March 7 has an interesting article regarding the use of saw dust mortar as a covering for steam pipes. A pipe of 6 to 8 inches diameter was boxed in a wooden box of 12 inches diameter, which was filled with saw dust mortar, one barrel of lime to five of saw dust. Before covering the pipe, nearly 700 feet in length, it condensed 1,440 pounds of water hourly; after covering it condensed 195 pounds hourly. This may serve as a hint to some of our saw mill friends that saw dust is even better to use in saving steam than in making it.

The Bell Telephone Company have just taken tenders for the erection of a new exchange in St. John, N.B., to be of stone and brick. Mr. F. P. Thompson is local manager.

# QUESTIONS AND ANSWERS

"R. T." writes: I cannot understand the way in which a compound alternator, which has a commutator, is wound. Would you be kind enough to give me a little explanation?

ANS.—There are two separate and distinct windings on the field of the alternator, one, usually called the separately excited field, being supplied by direct current from the exciter, and in which the current is practically constant, irrespective of the load, analagous with the shunt field of a direct current machine; the other, called the series winding, being supplied with direct current from the commutator of the alternator, this current, and therefore the field magnetism produced by it, rising and falling in direct proportion to the load. The commutator of the alternator, which is exactly the same in its action as that on a direct current machine, is supplied with alternating current either by putting it in series with the armature winding, and therefore the line which the alternator supplies, or else by putting a current transformer in series with the armature and line, the alternating current produced by its secondary, which will be proportional to the primary current or load of the alternator, being commutated and sent through the series field instead of the primary current.

"Student," Montreal: Would you please give me the formula by which to calculate the power necessary to drive a street car or pull a train of cars?

ANS.—The simplest formula is the following, viz.:

$$\text{Horse power} = \frac{\text{Tractive effort in pounds} \times \text{speed in miles per hour}}{375}$$

The tractive effort varies from 15 to 30 pounds per ton, depending on the state of the rolling stock and the rail; it is practically constant for all speeds up to, say, 30 miles per hour.

"Electrician": I cannot get any information on the Mershon compensating voltmeter, and as I have been told that it will compensate for any line loss without compounding my generators, I would be glad of any advice you can give me on the subject.

ANS.—You are apparently laboring under a mistaken impression regarding the instrument which you speak of, which is very general, but nevertheless quite erroneous. It is not a compensating voltmeter, in that it will change the generator voltage to correspond with the load changes, and thus keep the receiving pressure constant, after the manner of a compound wound alternator; but it is a meter which gives the true reading at the receiving or load end of the line, irrespective of the power factor and amount of the load, this result being accomplished through the use of an instrument called by its makers a compensator, and containing a potential transformer, a resistance and a reactance, all being so connected with each other and the meter that the resultant E.M.F. on the latter is proportional to the generator pressure, the reactance E. M. F. and the resistance E. M. F. As the resultant of these three voltages is the voltage at the receiving end of the line, it follows that an instrument actuated by their proportionals will give a true indication of this voltage, taking into account the power factor of the load, which affects the reactance drop to a greater or less extent as it recedes from or approaches unity, and the resistance drop, which varies directly with the load.

"Engineer": I am laying out a new system of piping for my engine and boiler room, and want to move my pump, which sometimes gives trouble when the feed water gets hot. I have been told that it should be piped so as to have the heater between it and the boiler; is this right?

ANS.—Any and all pumps should if possible be located so that the supply of water or other liquids which they may be handling flows to them by gravity. Especially is this true of pumps required to handle hot water, because if they are required to lift by suction their incoming supply, the vacuum which this suction tends to produce will often reduce the pressure of the water to a point which will allow the latter to steam, even though its temperature be considerably below the boiling point at atmospheric pressure. As soon as the steam is formed it breaks the vacuum, and the pump, relieved suddenly of its load, starts to jump. The remedy for this trouble is to change your piping so that the heater will be between the pump and the boiler, and in addition supplying the former if possible by water which flows into it by gravity.

"R. Wilson," Hamilton: I am trying to make an oil tight joint in a tank and want to get a composition which will expand on cooling; can you give me the formula?

ANS.—You will probably find that the following will give you good results, viz.: Lead 9 parts, Antimony 2 parts, Bismuth 1 part, all proportions by weight.

"F. T. W.," Dartmouth, N.S., writes: (a) When tendering for wiring contracts how much work is it usual to estimate for one man per day for cleat work and concealed work? (b) Are the American Underwriters' rules for wiring, which were published in the CANADIAN ELECTRICAL NEWS a short time ago, the same as the Canadian rules in use to-day? (c) In the above rules it was stated that No. 14 B. & S. guage to be the smallest wire allowable for inside work. I have seen smaller wires used since that time.

ANS.—This varies very much, running about 10 to 15 lights per man for 10 hours work on open cleat wiring and from 5 to 15 for concealed work, depending very much on the number of lights per outlet. (b) The Canadian Board of Fire Underwriters have adopted complete the National (U.S.) rules, and therefore all work done in buildings whose insurance is carried by a company which belongs to the Canadian Board must be made to comply with the National Code, which is the one obtaining generally throughout the States. (c) No. 14 is the smallest conductor allowed by the above rules except for fixture and pendant wiring, in both of which cases as small as 18 is allowed, though for the latter work it must be stranded.

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Hopkins' "Telephone Lines and Their Properties," a work already well known to those identified with telephony, has been revised and enlarged as the sixth edition. Several chapters have beee almost entirely re-wrttten, many diagrams added, and the number of half-tone illustrations largely increased. An account of the latest developments in the design of long lines and a short chapter on composite working and wireless telephony, have been added. The book is one which commends itself to the fraternity. Publishers: Longmons, Green & Company, 93 Fifth Avenue, New York; price $1.50.

## TURBINE BUILDING IN SWITZERLAND.

Prof. Franz Prazil, of the Federal Polytechnic Institute in Zurich, contributes an interesting and instructive article to the Engineering Magazine under the heading of "Turbine Building and Turbo-Electric Stations in Switzerland." In that country the manufacture of turbines has developed to a marked degree, and is now carried on by twelve companies, whose machines are sold all over the world. Five of these companies have made turbine building the main branch

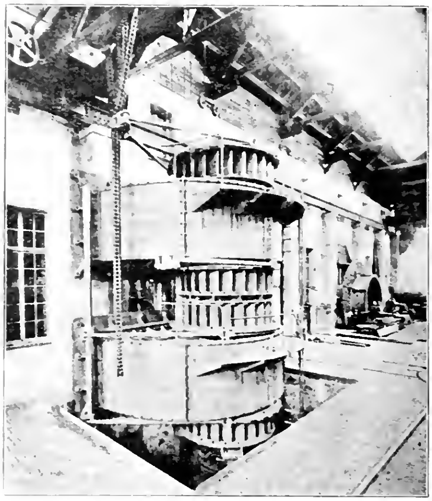

Fig. 1.—A 130 Horse Power Turbine Designed for the Electrical Works at Hagnek, Switzerland, as it appears mounted in the Shops of The Theodore Bell Company, of Kriens.

of their business, and the total production of these five companies from 1844 to the end of 1899 was 5,850 machines, with a total capacity of 638,000 horse power.

In the second half of the eighties the production of turbines began to make a striking though somewhat spasmodic advance. This was the period in which the first large hydro-electric stations were designed and built, thereby making vital a series of problems whose solutions demanded the best efforts of the engineer. Among these problems wete the construction of exactly working automatic governors, and an increase in the number of revolutions with even small heads, so that wheels could be directly coupled to electric generators. The first large hydro-electric stations, which were built in 1889, were the Schaffhausen central station and the power station of the Neuhausen Aluminum Company.

In the Shaffhausen station, two-ring reaction turbines drive the horizontal shafts of the generators through bevel gearing. Each turbine is constructed for a capacity of 300 horse power, with 15 foot head. The turbines of the Aluminum Company, which are directly connected to dynamos, have a novel feature designed to lessen the pressure on the bearings of the vertical shafts. These otherwise nominally constructed reaction turbines, each having a capacity of 600 horse power with 66 foot head, are so arranged in their casings that the water flows through them from below upward, and thus causes an upward pressure in the direction of the axis which counterbalances the downward pressure due to the weight of the various parts. Besides this, as the energy required varies rapidly, there is a quick-acting throttle-valve in the siphon-shaped delivery pipe which satisfies the requirement for prompt regulation.

In 1890 the hydro-electric station at Berne was built. On account of the considerable variations in head, from 11.5 to 6 feet, the three 150 horse power reaction turbines are constructed with three rings, the middle ring having an automatic governor and the other two being regulated by hand.

In 1891 was begun the installation of the Zurich electric station at Letten, the hydraulic plant of which is remarkable in several respects. The dynamos can be driven by two sets of turbines. One set is fed by the main reservoir of the water-works, while the second set, consisting of high pressure turbines, obtains its water from an auxiliary reservoir, which is filled by pumps at the waterworks whenever there is a surplus of power. The 300 horse power high pressure turbines have spoon-shaped buckets and are provided with hydraulic governors. The construction of turbines and governors was not first made in 1891, but this plant gave an opportunity for a series of experiments in regulation which were of importance for the development of such arrangements of water wheels.

In the years 1892 to 1896 a number of great works were undertaken, each one of which showed an advance in hydraulic construction. The turbines of the plant at Interlaken, on the Aar, are double ring reaction turbines with patent aspirators; the Schaad automatic governor was used for the first time with them. The turbines in Olten-Aarburg are three ring reaction turbines of large dimensions, and are characterized by a very thorough equalization of the blade angles in each ring. The employment of a forged shaft, hollow throughout, is also worthy of mention. In these installations we find already a striving towards the most exact regulation possible, as the use of the above named governors led to satisfactory results. But it is undeniable that there was found no adequate solution of the difficulty encountered if high speeds were to be used, although this would have been desirable on account of the comparatively small and very variable heads which

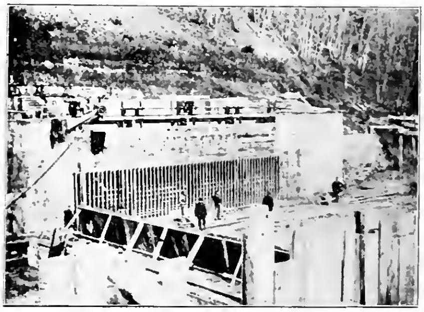

Fig. 2.—Sluice Gate at Entrance to Head Race Tunnel, Zufikon-Bremgarten Electro Hydraulic Installation.

are characteristic of the conditions of the plants referred to.

During the period from 1892 to 1896, the electric stations at Rathausen, near Luzern, and in Zufikon-Bremgarten, were erected on the Ruess. The hydraulic machinery of the Rathausen installation is of the low pressure type. With a head varying from 13.5 to 15.8 feet, this station has a capacity of from 1,200 to 1,500 horse power, which is converted into electric energy

by means of direct-coupled, two-phase generators with a voltage of 3,300, and thus supplies Luzern and the vicinity with power and light.

The plant in Zufikon-Bremgarten is of high interest, because it shows a decisive attempt to increase the number of revolutions. A view of the sluice gate at the entrance to the head-race tunnel is shown in Figure 2. The plant is situated near the town of Bremgarten, where the Ruess makes a bend of nearly 180 degrees. By building a dam 230 feet long at this point, a head of from 16.4 to 21.3 feet was secured, and the water is led through a tunnel 1,150 feet long, the maximum flow being 883 cubic feet per second, directly to the turbine house. In order to secure a higher speed the turbines are double ones in concrete casing. There are four units, each of 325 horse power at 115 revolutions per minute, and each directly coupled to a 5,000 volt polyphase generator.

ALUMINUM SOLDER.—(1) 1.55 parts tin, 23 zinc, 5 silver, and 2 parts aluminum. (2) 89.5 zinc, 4.5 copper, and 6 parts tin. (3) 94 parts of tin and 6 of bismuth.

An extract is stronger than the original substance. A concentrated campaign in a few good papers is more effective than small space in a great many.—Current Advertising.

## CANADIAN ELECTRICAL ASSOCIATION.

Reports received from the various committees which have in hand the perfecting of the arrangements for the annual convention of the Association at Ottawa, are most satisfactory.

A splendid list of papers has been secured. Interesting reports will be presented by special committees appointed at last year's meeting to consider certain matters affecting the welfare of the electrical companies. The constitution has been carefully revised, improved in many points, and rendered more workable. The local committee are exerting themselves to the utmost to give visitors to the convention an interesting, enjoyable and profitable time.

The last word received from the capital states that a satisfactory turn-out of the members is now the only requirement for the success of the meeting.

The dates selected for the convention are the 19th, 20th and 21st of June, the most enjoyable season of the year, when most persons are looking forward to an outing. All the conditions are therefore favorable to a large attendance and a successful meeting.

Mr. E. W. Holst has resigned his position with the Canadian General Electric Company at Peterborough, Ont.


GLASGOW EXHIBITION BUILDINGS—VIEW OF MAIN BUILDING FROM THE NORTH.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
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Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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Subscribers are requested to promptly notify the publishers of failure or delay in the delivery of the paper.

***EDITOR'S ANNOUNCEMENTS.***

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**Electric Lighting Leads.**

THE Committee on Light of the Board of Legislation of Cincinnati recently visited a number of the leading cities of the United States to enquire into street lighting methods. Their report shows that electric lighting, especially by means of enclosed arc lamps, has given the most satisfactory results for business streets. In Boston Welsbach lamps are to some extent being replaced by arc lamps, while in no instance have arc lamps been replaced by Welsbachs.

**Electric Railway Consolidation.**

THERE is said to be a marked tendency in the United States towards the consolidation of electric railways now operated independently. The prophesy is made that the electric railway lines when thus consolidated will become strong competitors as passenger and freight carriers of the steam roads. Perhaps so, but such has not been the outcome of consolidations in this country. As independent systems the electric railways act as an effectual check on the steam roads as regards their charges for local passenger and light freight service. If amalgamated and operated as a single system, one of two results might be expected to follow, neither of which would benefit the public. Either the electric consolidation would sell out to the steam road consolidation, or a cast iron agreement as to rates would be entered into between the two. As between a situation of that kind and the one now existing, the public would seem to be infinitely better off with things as they are.

**The Manhattan Railroad Equipment.**

WHEN the changes now under way on the Manhattan elevated railroad of New York city are completed, another example of the advantages of electric traction will have been provided. With a view to adopting the best possible system, the company built a short experimental line on which experiments and tests were made. About a year ago the contract for the electrical equipment of the power house was awarded to the Westinghouse Company. Within the past month a contract has been closed with the General Electric Company for the rolling stock equipment, involving apparatus and supplies approximating $3,000,000, said to be the largest contract ever awarded to an electrical company. It specifies the multiple unit train control, with motors for 800 main cars and half that number of trailers. As each motor car will have two motors, there will be 1,600 motors for these cars alone. A provision of the contract is that the motors shall be delivered within ninety days.

**Steel Rail Manufacture in Canada.**

APART altogether from the question which has been recently under discussion in the Dominion Parliament regarding the advantages or disadvantages of the terms of agreement made by the Minister of Railways and Canals with the Clergue Syndicate for the manufacture of steel rails at Sault Ste. Marie, Ont., for use on the Intercolonial Railway, it must be gratifying to every Canadian to learn that the manufacture of steel rails is to be commenced in Canada. It is a natural outcome of the rapid development of the iron and steel industry which is now taking place in this country, and we hope that the enterprise may prove successful. Experiment is to be made with the manufacture of a nickel steel rail, which it is believed will prove

very much superior to the ordinary steel rail now in use. Should expectations in this direction be realized, this country would enjoy a very distinct advantage in this line of manufacture, seeing that we have probably the most extensive deposits of nickel in the world.

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**Exit the Tall Chimney.**

MR. Edward Atkinson, the well known insurance authority, of Boston, recently took part in a public discussion in that city relative to the means which might be adopted to abate the smoke nuisance. He held that the days of the tall factory chimney were numbered, and that the chimney of the future would be a low stack of large area, the draft for which would be supplied by mechanical means. But what substitute shall be found for the tall chimney as an evidence of our prosperity as a manufacturing nation?

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**Electrical Development in Great Britain.**

ELECTRICAL development in Great Britain is proceeding at a much faster rate than ever before. This statement specially applies to electric traction, which branch has absorbed nearly half the total investment in electrical undertakings, estimated at £123,000,000. There are 470 miles of electric railways in operation and 500 more in course of construction. In London alone there are in operation 14 miles of underground electric railway and 40 miles under construction, while the future development can be gauged by the fact that seventeen new lines are now being promoted. The great success of the electric street railway at Liverpool has had much to do with the introduction of electric traction in other provincial towns. The establishing of large works in England by the Westinghouse Electric Manufacturing Co. is a practical evidence that in the opinion of that shrewed concern there is to be a large growth in electrical undertakings in the mother country in the near future. The average return on the capital already invested in such undertakings is given as 5½ per cent. which to the British investor will probably be satisfactory.

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**Niagara Falls Power.**

IT was announced last week that work had been commenced looking to the development of the power on the Canadian side of Niagara Falls, under the charter held by the Canadian Niagara Power Company. It was even stated that a well known Canadian firm had secured the contract for the electrical apparatus. Although some work was no doubt in progress in the locality of the proposed development, it was not generally believed that the company was about to proceed immediately to construct works, as previous announcements of a similar character had proven groundless. At the time of writing it has been found impossible to confirm the reported award of the contract for electrical machinery, and the intention of the Canadian Niagara Power Company is still in doubt. The agreement with the Canadian Niagara Power Company was first made in 1892. It was revised in the fall of 1899, and under the agreement now existing the company must pay a rental of $1.50 per horse power per year for the first 10,000 horse power developed, $1 per horse power for the next 10,000, 75 cents for the next 10,000, and 50 cents per horse power for all above 30,000 horse power. Since the new agreement, what might be termed an opposition company has been formed, the Ontario Power Company, which proposes to utilize the waters of the Welland river. These companies have no doubt learned with satisfaction of the successful transmission of electric power from the Tuba river to Oakland, California, where it is used for operating the street railway system. In this undertaking the voltage used is 40,000. If it is found profitable to transmit current a distance of one hundred and forty miles in California, the transmission from Niagara Falls to Toronto should offer no obstacles which cannot be overcome. Of course in California coal is much more expensive than in Ontario, thus giving a water power plant there an advantage. Granting that the power can be sold at a reasonable price, there should be no lack of demand. The Toronto Electric Light Company and the Toronto Street Railway Company would doubtless be willing to close down their generating plants if it could be shown that Niagara power could be obtained at a lower cost than that at which it is being produced in their power stations. The Montreal Street Railway Company have made a move in this direction, having contracted with the Chambly Power Company for 5,000 horse power at the price of $25 per horse power per year. The cost of coal is a most important consideration in the operation of steam power plants. At the present time only two United States companies are shipping soft coal to Toronto, and developments on the other side have been such that an amalgamation of these two companies might be expected at any time. The result of this would be to advance the price of coal, thus increasing the cost of producing electric power by steam. Then a more favorable opening for Niagara power in Toronto and other places distant from the Falls would be offered.

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**Electricity at the Pan-American Exhibition.**

THE beautiful and interesting decorative displays at the Chicago and Paris exhibitions were made possible by the use of electricity. To this agency was also due the opening of the Exhibitions at night and their perfect illumination. At the Pan-American Exhibition which opened a few days ago in Buffalo, electricity will play a more important part, for decorative and illuminating purposes than ever before. The near proximity of the immense generating stations at Niagara Falls puts at the disposal of the management almost unlimited facilities in this direction. We are told by the official magazine that the number of lights and the quantity of light will exceed that of any other equal area ever artificially illuminated, and it will be evenly distributed; that unusual spectacular effects will be produced by the many combinations of light and water and these combinations are to be so graded as to climax in keeping with the decorative lights at the electric tower; that the electric tower basin will be the stage of the display of a combination of 1,500,000 gallons of water per hour in fountains with the light of 100 large-sized searchlights.

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Mr. James Douglas Reid, known to telegraphers throughout the country as the "Father of the Telegraph," died in New York on April 28th. Mr. Reid gained his destinctive title because he was a pioneer in establishing the telegraph and was associated with the inventor, Prof. Morse. Born in Edinburgh in 1819, he moved with his family to Toronto in 1834, becoming junior clerk in a bank. He removed to the United States in 1837 and took a contract for the construction of a telegraph line from Philadelphia to Pittsburg. Later appointments were as superintendent of the Megantic Telegraph Company, Atlantic & Ohio Telegraph Company, and the New York, Albany & Buffalo Telegraph Company. He founded and edited the National Telegraph Review in the early fifties, and in 1877 published his first edition of "The Telegraph in America."

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, MAY 5TH, 1901.

## RULES GOVERNING ELECTRICAL INSTALLATIONS.

In the new building by-law passed by the city council on February 4th, 1901, the clause governing the installation of electric apparatus, etc., for electric light, heat and power reads as follows:

Section 116. All the electric apparatus, wires, etc., for the generation or supply service in any central station or isolated plant, and all wires, lamps, motors, etc., used for light, power or heat in any public or private building, shall be installed according to and in conformity with the rules and regulations of the Canadian Association of Fire Underwriters, and in order to secure conformity to said rules and regulations, all such installations shall be subject to inspection and issuance of a certificate to that effect from the electrical inspection department of the city of Montreal. In order that proper inspection may be made, due notice shall be given to the building inspection office of any intention to install any such electrical wires or apparatus for the purposes herein mentioned, in order to allow of inspection of the installation as the work progresses, and before any portion of such work is covered or concealed, and no installation shall be considered complete and in conformity with said rules and regulations, until a certificate shall issue from the inspection department to that effect. In all cases, the inspection department shall have power to decide and determine whether such work has been done in a safe and proper manner, and the issuance of a certificate therefor shall be in evidence thereof.

(a) All materials, switches, wire, or any other auxiliary apparatus or device partaining to said installations, shall be subject to the inspection department before being used for such purpose.

(b) All wires of any description, either for telegraph, telephone, electric light, heat or power, on, or entering any building, public or private, shall be subject to the supervision of the inspection department, and with power on the part of said department to compel the placing of those wires in a proper and safe manner.

(c) All theatres and all public halls for scenic display shall be subject to inspection at least once a year.

(d) In case of any installation already in operation, either of generating plant, motors, wires, or other electric apparatus located in any building or premises, becoming defective, to such an extent as to threaten immediate danger to life or property, the inspection department, having notice thereof, shall have immediate power to suspend the operation of such, pending the necessary repairs.

(e) The Inspector and City Electrician shall, at proper hours, have the right to enter any building or premises where electric power or light is being used, to inspect all electrical wires or apparatus, in order to ascertain if the proper regulations have been complied with, and no person shall refuse to allow such inspection.

(f) No alteration or change shall be made in the plan of wiring any building, without notifying the Inspector and securing a permit therefor, and subjecting the plan of wiring to inspection, as herein provided.

## MCGILL EXAMINATIONS.

The results of the examinations of McGill University were announced a few days ago. The following students were successful in electrical and mechanical engineering, and are entitled to the degree of B. A. Sc.:

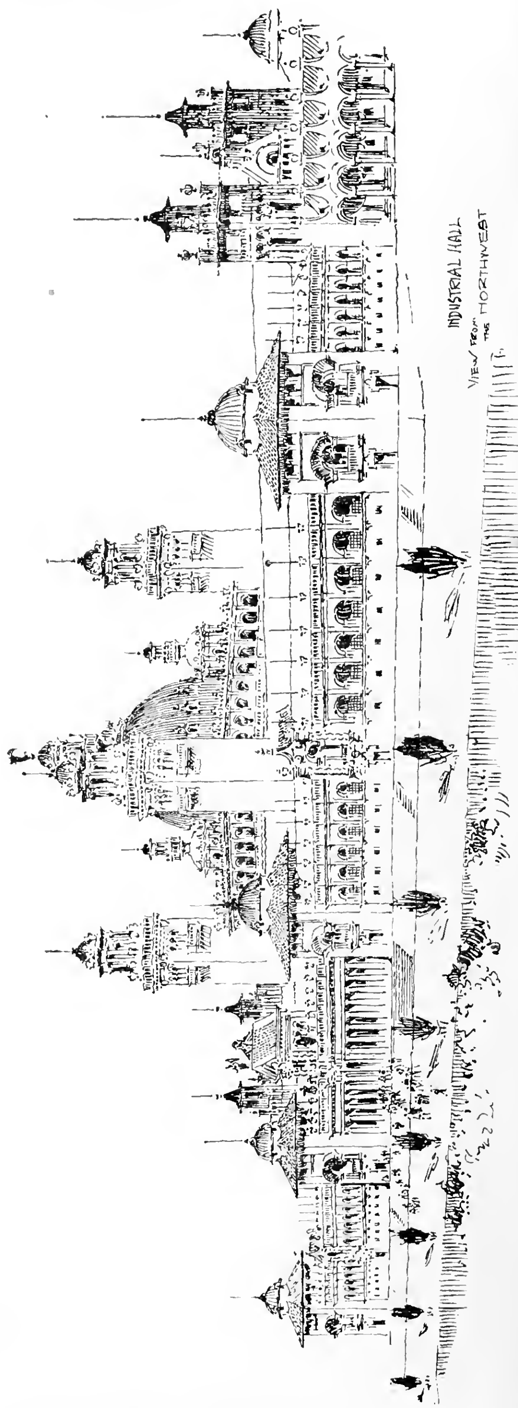
Electrical Engineering—McLaren, J. H.; Burson, H. A.; Glassco, A. P. S.; Taylor, C. W.; Howard, R. F., and Walker, F. W., B. Sc., equal; Coussirat, H. A.; Neville, T. P. J., B. Sc.; Wenger, E. L., B.A. Sc.; Sise, P. F.; Ward, P. W., Lloyd, H. M., Scott, H. M. Mechanical Engineering—Schwitzer, T. H.; Burwall, E. V.; Hampson, E. G.; Cameron, H. D.; Lowden, W. K.; Wilson, R. C.

In the third year the successful students in the electrical and mechanical courses were:

Electrical Engineering—Harry E. Scott, Napanee, Ont.; Emerson S. Franklin, Wolfville, N. S.; Philip T. Jackson, Toronto; Marshall A. Maxwell, St. Stephen, N. B.; Thomas N. Hicks, Perth; J. Macd. Smith, Petitcodiac, N. B.; John C. W. Dunfield, St. John's, Nfld.; William E. Murphy, Shelburne, N. S.; Eric J. Mackay, St. Johns, Nfld. Mechanical Engineering—Frank E. Stearns, Merell, P. E. I.; Gerald M. Smith, St. John's, Que.; David M. Fry, Bright, Ont.; Thomas H. Addie, Sherbrooke; Alex. Baird, Sherbrooke; Emil R. Newton, Drummondville, Que.

The results of the second year in the same branches were as follows:

Electrical Engineering—Alvah E. Foreman, Vancouver; Roscoe V. Conklin, Winnipeg; Alex. S. J. Peaslee, Ohio; Herbert F. Rodger, St. John's, Nfld.; James F. McDonald, Westville, N. S.; Franser S. Keith, Smith's Falls; Harry E. Blatch, St. John's, Nfld.; Charles L. Trimingham, Barbadoes, W. I.; C. Percy Cole, Montreal; Charles W. Stokes, Woodstock; K. McCaskill, Vankleek Hill; Wm. H. Sharpe, Montreal; Hartley M. Pearson, Huntingdon; Wm. E. Baker, Montreal; Bertram James, Heart's Content, Nfld.; Walter R. Brechen, Charlottetown. Mechanical Engineering—Fred. R. Brown, Montreal; Arthur R. Roberts, Montreal; Fred. A. McKay, Montreal; Chas. M. McKergow, Westmount; Reginald D. J. Denne, Montreal; John H. Edgar, Montreal.




GLASGOW EXHIBITION BUILDINGS—INDUSTRIAL HALL.

United States consolidations are going it; the latest on the tapis is a consolidation of interests of the manufacturers of incandescent lamps.

It seems strange that while under the British flag, English fittings of certain kinds cannot be used if a clear certificate is to be had. The English Board of Trade are surely as anxious to safe-

guard fire interests as is the United States National Board of Fire Underwriters, but because we have "swallowed" the United States rules, strictly speaking, no fittings but those of United States manufacture could be accepted.

Montreal contractors are beginning to wonder if we have an alien labor act in Canada, or if it is only an illuminated document to be admired?

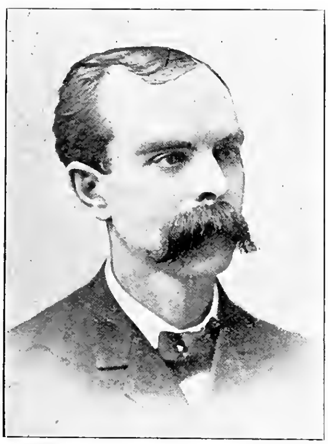
The latest is: One of 'nos compatriotes' in Montreal writes a prominent United States firm as follows:- "I am handling several electric goods as agent, and would like to know if I can have the agency for your goods for Montreal and suburbs, that is Quebec, Ottawa and Toronto!"

The question of grounding the centre of the secondary of transformer is arousing a little interest here. One or two isolated requests have been made by consumers of both Royal and Lachine current to have this done. There is as competent authority against this practice as there is for it, consequently it would be well in a matter of this kind, evolving as it does a radical change, to "make haste slowly" and profit by the experience of others. Should this practice come into vogue, considerable more care will require to be taken by certain manufacturers of transformers.

Mr. H. O. Edwards, who has been favorably known as assistant to Mr. W. H. Brown, the general manager of the Royal Electric Company, has under the new consolidation of interests been moved to the Canadian General Electric Company's quarters in Toronto. Mr. Edwards was for a number of years with the Royal, and is esteemed by all the "old boys" who will miss him here, but who wish him luck in his new sphere.

## DEATH OF A CANADIAN ELECTRICAL INVENTOR.

Canadians generally, and the electrical fraternity in particular, have learned with deep regret of the death,



THE LATE JOHN C. HENRY.

at Denver, Colorado, on May 4th, of Mr. John C. Henry, to whom is due in large measure the improved methods and principles of the trolley street railway system now so largely in use throughout the world. Mr. Henry was a pioneer in the electric railway field, the inventor of the principles employed in the first electric railroad ever built in America.

That Mr. Henry was a Canadian by birth is perhaps not generally known. He was a son of Mr. Thomas Henry, of Woodstock, Ont., and spent the early part of his life in that city. He was first employed in Woodstock as a telegraph operator for the Montreal Telegraph Company, and later as night operator at the G. T. R. station. When twenty years of age he went to the United States, and after working as a telegraph operator in Kansas, occupied prominent positions with the General Electric Company, of Schenectady, N. Y., and the Westinghouse Electric Company, of Pittsburg, Pa.

When working as an operator he gave much study to various inventions bearing upon electric traction, and as a result was engaged by a celebrated author and lawyer, the late Judge Henry, to build an electric railway out of the town of Independence, according to certain designs which the young operator had drawn in his spare moments. At that time there were no electric roads. Electric traction, to use Mr. Henry's own words, was about as far advanced as aerial navigation is to-day. The plan of running a wire above the car and establishing contact with it by means of a pole was the product entirely of Mr. Henry's brain. On the road-bed below it was unnecessary to place anything but the rail. So successful did the line to Independence prove that for many years its principal features were followed in electric railway construction everywhere. How little was known throughout the country at that time in regard to electric traction may be judged from the fact that one of the foremost cable engineers in the country assured the president of the Kansas City Railway that it was impossible to run cars with self-contained power up a seven per cent. grade, "because the wheels would slip." Yet in 1886 the East Fifth Street railway in Kansas City was equipped with four motor cars, and after the road was opened several other electric railways planned after it were constructed in California.

The first electric car designed by Mr. Henry is still intact in Kansas City. He used for the motor an old generator in which the current was reversed. It stood in the middle of the car and ran all the time, the car being started and stopped by connecting and disconnecting the axles from the motor. When the first line was built Mr. Henry was assured by a prominent electrical engineer that it would take copper generators as large as his thigh to carry current enough to operate the machinery. To build the trolley wires it was necessary to buy copper rods and solder them together, as no wire was drawn in continuous lengths of the necessary size. The obstructions seemed insuperable, while the experts of the day offered every discouragement. It was only Mr. Henry's confidence that he was right and that the electric railway was a possibibility that kept the experiments moving until the trolley was heard all over the country.

Mr. Henry also devised the carbon brush for electric generators, the swinging trolley controlled by a rope, the direct connected motor, and step-up and step-down transformers by which the long distance transmission of power was made possible. Details of the latter invention were, however, worked out by other hands.

When Mr. Henry's failing health compelled his removal to Denver he established a small work-shop, where he worked when his strength permitted upon various inventions and improvements, from some of which, it is said, he recently realized a considerable sum. One month before his death he was engaged on an automobile motor, said to embody new ideas in automobile construction. His brain was most active at night, and through the silent hours he worked out the details of inventions and improvements in one of the most difficult and technical of scientific branches. Mr. Henry's son will, it is understood, carry out the plans of his father as far as is possible.

As is frequently the case with inventors, Mr. Henry apparently did not realize the financial value of his inventions. Had it been otherwise he might have been many times a millionaire.

Mr. Henry was about fifty years of age. The accompanying portrait is reproduced from a photograph taken some time ago.

## ELECTRIC HAULAGE SYSTEM FOR SHIPS.

In the February number reference was made to an electric marine railway in operation at Liverpool, Nova Scotia. Herewith we give two views of the plant and some further particulars regarding the installation.

The plant was devised for the purpose of hauling vessels out of and lowering them into the River Mersey, a distance of over 500 ft. on an incline having a grade of half an inch to the foot. Some years ago the Liverpool Marine Railway Company, Limited, had a slip of this kind in operation, whose motive power was horses. A framework carried two horizontal gears attached to which was a beveled gear with a vertical shaft projecting upward, and working on this were two long arms or sweeps. To these were hitched two or four horses travelling around on an upper platform, which was reached by a runway outside the building. The animal power was, of course, limited in its capacity, and extremely slow, it taking three to four hours to haul up a small vessel in the cradle. While the vessel was undergoing repairs, it was held from running back by a great dog in a ratchet. When the work was finished it was the custom to knock out the dog and let the cradle go "by the run" back into the water. It is almost needless to say that this crude method soon wrecked the cradle and the track as well. The result was that the whole plant fell into disuse and decay.

During the past year a new company was organized with the object of rebuilding and equipping the slip in an up-to-date manner, and when it came to the question of the best power it was decided to use an electric motor, there being, moreover, a lighting system in town driven by water power, from which the current could be obtained very cheaply. A Stanley or S. K. C. 30 h. p. induction motor has been installed, which will raise and lower ships of a burden up to 400 tons, over a track which is 600 feet in length, in the remarkably quick time of 25 minutes. The equipment has so far proved a very economical and highly satisfactory investment. The motor is geared to a worm, which in turn operates a further train of gears, as illustrated in Figs. 1 and 2 herewith. On the shaft of the large and last gear is a sprocket which engages an endless two-inch chain that hauls the cradle. The whole thing is as

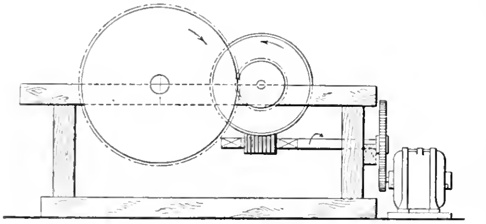


FIG. 1.—LIVERPOOL MARINE HAULAGE SYSTEM.

simple as possible. It will, of course, be understood that the gears and sprockets are within the frame and not outside, and it may be added that the frame is much heavier than shown. It was found feasible to use much of the old gearing. The framework was set on a bed of concrete 3 feet deep and fastened firmly into place by heavy rods running up through the concrete and frames. It also butts against the end of the slip, so that there is not the slightest chance for it to move.

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It has been arranged to hold the next annual meeting of the Old Time Telegraphers' Association in the city of Montreal on September 11th, 12th and 13th next.

## EXTENSION TO POWER PLANT.

The West Kootenay Power & Light Company, of Rossland, B. C., are about to make a large addition to their power plant at Bonnington Falls. Mr. L. A. Campbell, the general manager, advises us that the contract has been let to the Canadian General Electric Company to install a 3,000 k. w. generator, 180 r.p.m., with three 1,250 k.w. step-up transformers and three 1,250 k.w.

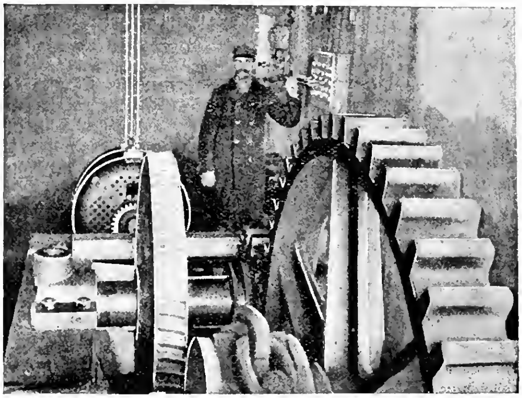

FIG. 2.—INTERIOR OF LIVERPOOL MARINE HAULAGE PLANT.

step-down transformers, and all necessary switch-board apparatus. The water wheel setting will be composed of four 45-inch Victor turbine wheels on one shaft, capable of delivering to the generator coupling 4,800 h.p. under 38 feet head. These wheels will be furnished by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. The structural iron work is in the hands of the Jenckes Machine Company, of Sherbrooke, Que. When the new apparatus is in operation it is understood to be the intention to raise the voltage to 30,000 volts. The company are developing hydraulic work for 12,000 h. p., and when the installation of the new 3,000 k. w. unit is completed, they will have an output in their plant of 8,000 h. p., with pen-stocks installed to be increased to 16,000 h. p. This company, it is said, have been negotiating with the C. P. R. for the operation of their road from Trail to Rossland by electricity.

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It is announced that the landing site for the Pacific cable in British Columbia has been purchased, and consists of 100 acres of land on Barclay Sound. The place is described as splendidly adapted for the station, from the fact that it is surrounded by perfectly smooth water, is well sheltered, and the bottom of the harbor is such as to furnish good protection for the wire. The site was selected by Mr. R. E. Seake, of the firm of Clark, Forde & Taylor, who is now en route to Brisban, Queensland, to select the landing place there, afterwards proceeding to Sydney, N. S. W., to join the steamship Britannia, which has been sent out to aid him in selecting suitable landing places and in a survey of the route from Queensland and New Zealand to a point about 70 miles north of Fanning Island. The manufacture of the cable will be commenced next month, and the first expedition in connection with the laying of it is expected to leave the Thames in January, 1902. This will carry out the laying of sections from Queensland to Norfolk Island, Norfolk Island to New Zealand, and Norfolk Island to Fiji Islands. The second expedition will leave about August, 1902, and will lay the cable from Vancouver to Fanning Island and Fiji. This long length of cable, 5,834.5 nautical miles, will be transported and laid by one ship, which is now being specially built for the purpose. The contractors undertake that the whole of the cable shall be laid and working by December, 1902.

# ELECTRIC RAILWAY DEPARTMENT.

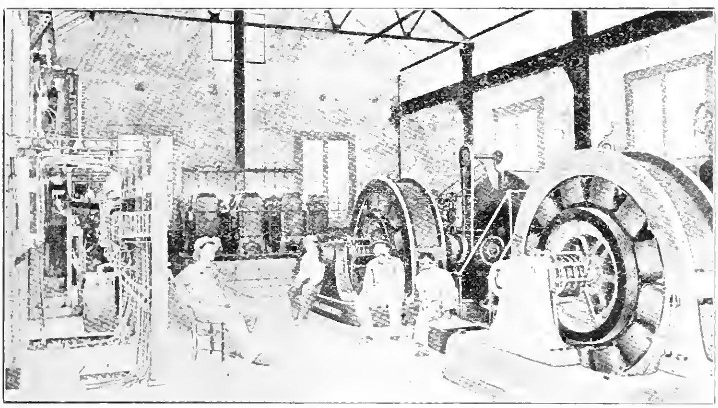
## THE STREET RAILWAY SYSTEM OF KINGSTON, JAMAICA.

A street railway system, built according to the latest improvements in every detail, is now in operation in Kingston, Jamaica, a city with a population of 50,000. About two years ago the West India Electric Company, Limited, an organization composed of Montreal capitalists, obtained the franchise to build and operate extensive electric street railway and lighting systems. The old car company was absorbed, and in a short time works involving an expenditure of upwards of $1,000,000 had been completed.

The original intention to operate the railroad from a steam power plant was abandoned on account of the cost of coal, and it was decided to develop a water power on the Rio Colre, twenty-one miles from Kingston. The contract to design and install the power plant complete was given to the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, who furnished their own designs and turned over to the company a finished installation. It happens that the Government road runs along the river bank at a height just sufficient to keep it above ordinary high water, but a location was finally found where a dam nine feet high could be built which would cause no inundation of the highway except at extremely high water, and the water could be piped to a lower point down stream, where a head of 54 feet is obtained.

The dam is built of concrete, and is 90 feet wide, with cross section. The intake of the pipe is ten feet in diameter, narrowing to eight feet. It is 6,240 feet in length and ¼-inch wheel riveted in six feet sections. It is one of the largest pipe lines in the world, and was constructed with untrained native labor, there being only two white men superintending the construction. The general superintendent was Mr. Henry Holgate, of Montreal.

The power house is built entirely of steel and concrete, and is carried on foundations from ten to sixteen feet deep. The building stands directly in the bed of the river and must needs be sufficiently strong not only to satisfactorily hold the machinery, but also to resist the freshets which come down, like all tropical floods, with tremendous force. The building is 70 x 36 feet, and is built with latticed columns and I beam girders throughout. The turbines are regular Stilwell-Bierce & Smith-Vaile wheels, designed to develop 400 h.p. at 40 r.p.m. The generators were manufactured by the General Electric Company. They are three-phase, stationary field, 12-pole, 300 k.w., 500 volt machines, designed to be used with step-up transformers, which are of the air blast type. Each generator feeds three transformers, which are connected with both secondary and primary in delta. The foundations for these transformers consist of concrete walls, 12 inches thick and 30 inches high, with a row of concrete piers down the centre. The air chamber is made by flooring the top of this foundation with 2 in. x 12 in. pitch pine plank. The low tension connections are made in the air chamber and are led through porcelain tubes into conduits in which they are carried to the switchboard. The high tension connections are made over-head and are let out of the building through 12 in. x 36 in. openings in the wall to cross arms, on which they are carried around the building to another set of openings, through which they are brought to the switchboard. The blowers are set on the floor directly at the west end of the air chamber, the motors being raised on concrete piers 12 inches high.



INTERIOR OF GENERATING STATION, WEST INDIA ELECTRIC COMPANY.

The switch-board consists of eight blue Vermont marble panels, two blank ones being left for the third unit. The high tension panels for each set of transformers contain only the high tension switches, which are of triple-pole, double throw, oil break form, the handle alone being on the front of the board. An auxiliary panel carries a triple-pole, single throw, oil break switch for paralleling the two transmission lines. All these switches are placed on the back of the board. The auxiliary panel is provided also with two astatic ground detectors and six ammeters connected to show the current in each phase. These ammeters are directly across the secondary of current transformers, thus avoiding all high tension in the front of the board. The generator panels are each equipped with three single-pole, quick break switches and the necessary

meters, field switches and synchronizing lamps. The exciter panels are equipped with the necessary switches and meters for two exciters, which operate at 110 volts. These exciters are four-pole, moderate speed machines of 25 k.w. capacity, each coupled directly to a single turbine 9 inches in diameter.

The low tension wires are all carried in conduits beneath the floor and rise only at the machines, switchboard and transformers. The high tension wires are carried on porcelain line insulators on wooden cross arms. From the transformer primaries they are run outside and are carried on long pitch pine cross-arms around to the middle of the west wall, through which they are carried directly to the high tension switches. There are two sets of bus-bars to which the two transmission lines are connected.

The transmission line is carried on two cross arms on tubular steel poles, four wires being on the upper, and two on the outer ends of the lower arm. Two telephone wires are carried on the lower cross arms next to the pole. There are six transpositions on the line, making two complete turns in the entire length, the transpositions being so made that the sets of three wires each spiral in opposite directions.

In the sub-station, which is of brick, there are two rotary converters, six pole, 200 k.w. capacity each. They are designed to run at 550 volts on the direct current end. The system being forty-cycle and the rotaries six-pole, they operate at 800 r.p.m. They are self-excited, compound wound, the compounding being done exactly as with a similar direct current generator, with the German silver shunt across the series field. When starting as a.c. motors there is, of course, a transformer action tending to induce a considerable potential difference across the field terminals. In order to avoid extremely high voltage across the shunt winding, the field coils are split up into three pairs of two inch series and are not connected until the machine is running synchronously. A switch is placed in series with the shunt to avoid a short circuited secondary effect through the series coils and the German silver shunt.

The step-down transformers are placed on a wooden air chamber, which in turn is placed over a duct or pit, through which the high tension wires run. The low tension cables run directly through a conduit to the switch-board. The primary leads are carried to a set of bus wires carried on short circuit cross arms on posts set between the two rows of transformers. These bus wires lead through the current transformers for the high tension meters to the oil break switches. The wires leading to the transmission line are connected directly to the high tension bus wire on the boards and pass directly down into the pit. Through the pit they are supported on line insulators on cross arms set in concrete on each end. At the opposite end of the pit they rise and pass up the wall behind the lightning arresters to two sets of cross arms, on which they are carried to the openings, through which the line enters.

The blowers and their motors stand on a wooden platform beyond the end of the air chamber, and are carried on the steel rails which cross the high-tension wire pit.

The switchboard in the sub-station is of blue Vermont marble and consists of nine panels, there being three for high-tension connections similar to those in the power house, one blank panel, two low-tension panels for the a. c. end of the rotaries, two standard railway panels for the direct-current side, and one feeder-panel for four feeders.

The step-up transformers step up to 14,000 volts, at which pressure the power is transmitted to Kingston, where it is stepped down to 345 volts for the rotaries. The relative field excitations are adjusted so that at about 3/4 load the rotaries will operate non-inductively. The rotaries may be started from rest, from either the a. c. or the d. c. side. The usual custom is, however, to start the generator and rotary from no cycles, and with a full field on the generator. It was found that with weak fields on the generator and rapid acceleration of speed the rotary will pulsate in and out of step, frequently reversing the polarity of the d. c. voltage. This is avoided by bringing the generator up to speed slowly, and keeping a strong field on the same. The normal non-inductive, full load alternating current for the rotary is 340 amperes, but only 200 amperes are necessary to start it from rest, and bring it up to speed as an induction motor.

The switch-boards are provided with switches and a starting rheostat, so that either rotary may be brought up to speed as a direct-current motor, and, after synchronizing, be thrown in parallel on the a. c. end with the other rotary.

The general design of the plant is such that either generator unit can be operated on either transmission line, and either rotary unit the same. For its size it is one of the best equipped and best finished plants in existence; in fact, the entire system, including the dam, power plants, car sheds, track, and overhead work, is of the most substantial construction.

The accompanying illustration of the interior of the power house and much of the above information are taken from the American Electrician.

## SCHOOL OF SCIENCE EXAMINATIONS.

In the spring examination in the Faculty of Applied Science and Engineering of the University of Toronto, the following obtained the degree of B. A. Sc.:

E. C. R. Ardagh, J. H. Barley, J. A. Craig, J. E. Davison, C. W. Dickson, W. E. Foreman, F. E. Guy, W. Hemphill, H. S. Holcroft, R. Latham, J. G. McMillan, E. V. Neelands, A. S. H. Pope, J. R. Roaf, H. W. Saunders, W. C. Tennant, S. M. Thorne, S. W. Thorold, H. M. Weir, H. A. Dixon.

The successful students in the mechanical and electrical engineering course were:

Third Year: Honors—W. G. Chace, A. Laidlaw, H. V. McVean, H. W. Price. Pass—W. G. Beatty, C. M. Bertram, W. J. Bowers, E. T. Brandon, W. P. Brereton, J. T. Broughton, C. A. Carmichael, A. G. Christie, J. R. Cockburn, N. R. Gibson, W. C. Lumbers, A. C. McDougall, A. T. C. McMaster, H. T. Middleton, M. V. Sauer, W. H. Stevenson.

Second Year: Honors—H. G. Barber, J. Breslove, C. Henwood, C. H. Marrs, P. Mathison, D. Sinclair, T. Taylor. Pass—J. M. Brown, H. V. O'Connor, R. J. Dunlop, W. Elwell, R. E. George, A. C. Goodwin, D. M. Johnston, A. H. McBride, J. T. MacKay, F. G. Mace, J. F. S. Madden, R. S. Mennie, H. D. Robertson, W. H. Sutherland, A. A. Wanless, H. Zahn.

First Year: Honors—H. H. Angus, F. A. Gaby, A. J. Latornell, M. L. Miller, B. B. Patten, D. H. Pinkney, H. M. Shipe, S. B. Wass. Pass—H. G. Acres, J. A. Beatty, M. B. Bonnell, A. E. Davison, H. H. Depew, S. W. Eakins, C. J. Fensom, A. Gray, J. G. Jackson, C. K. Johnston, W. J. Larkworthy, J. A. McFarlane, C. A. Maus, W. G. Milne, P. H. Mitchell, E. E. Mullins, I. H. Nevitt, J. P. Oliver, J. D. Pace, R. B. Ross, H. S. Small, H. G. Smith, S. L. Trees, H. F. White.

In a car a small boy was observed to be suddenly agitated. Soon the conductor asked for fares. When he stood before the small boy there was a slight pause, and the passengers were surprised to hear the following: "Pleathe charge it to my papa; I've swallowed the money."

## CURVES OF WEIGHT AND SPECIFICATIONS FOR ELECTRIC RAILWAY BRIDGES.

By H. G. Tyrell, Civil Engineer, Boston, Mass.

The curves shown in the accompanying diagram, prepared by H. G. Tyrell, C.E., of Boston, Mass., give the weights of electric railway bridges of spans from 5 ft. to 200 ft. for both light and heavy cars. The points adjoining the curves are actual weights, and from them the curves have been plotted. The weights include the steel only, without safety stringers. The spans are proportioned for either single truck or double truck

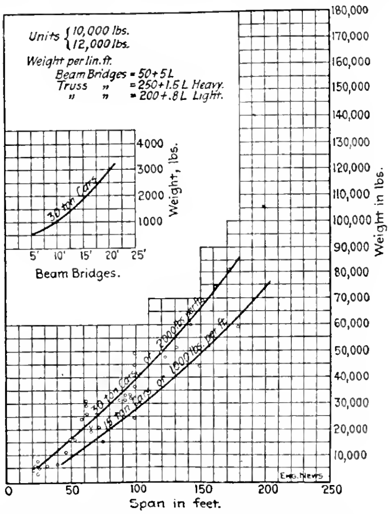



Diagram Showing Weights of Electic Railway Bridge Spans, from 5 ft. to 200 ft. in Length.

cars, and the load is considered to cover the span from end to end. Lighter bridges than these can, of course, be made by proportioning them for say two or three cars only on the span at one time. The units taken are 12,000 lbs. per sq. in. for tension and 10,000 lbs. reduced by Gordon's formulas for compression. The details are figured for riveted joints.

In connection with these curves it is interesting to note that the following specifications for electric railway bridges have recently been adopted by the Board of Railroad Commissioners of Massachusetts:

For bridge floors either a 20-ton 4-wheel car with 7-ft. wheel base, or a 30-ton 7-wheel car with 17-ft. total wheel base and 4-ft. truck wheel base is assumed. The fiber stresses to be used in the floor are as follows, the material being medium steel, namely: For I-beams 12,000 lbs. per sq. in. properly reduced according to the ratio of width of flange to total length, when this ratio exceeds 20; for plates and shapes, 12,000 lbs. per sq. in., in tension, and 12,000 lbs. per sq. in., reduced by the usual formula according to the distance unsupported; for rivets in shearing, 10,000 lbs. per sq. in. and in bearing 16,000 per sq. in. for shop-driven rivets; field-driven rivets to be reduced 25 below these figures. No rivets less than ¾ in. are to be used.

For trusses, uniform loads shall be assumed, varying according to the length which is to be covered by the live load to produce maximum stresses, from 1,500 lbs. per running foot per track for a loaded length of 100 ft. down to 1,000 lbs. per running foot of track for a loaded length of 300 ft., and proportionately for other lengths. Due account must be taken in the case of pieces which receive concentrated loading from the floor loads. The factor for trusses may be larger than that for the floor. The following may be the stresses per square inch: For tension, 15,000 lbs. per sq. in.; for compression, 12,000 lbs. reduced by the Rankine formula; for rivets the same stresses should be used as for the floor.

### ORIGINAL FORMULÆ FOR THE WEIGHT OF BRIDGES.

RAILROAD BRIDGES.

All weight are per lineal foot of single track bridge. Steel only.

Live loads, two engines, 100 tons each, and 4,000 lb. per lineal foot of track, units 10,000 lb. and 12,000 lb. per square inch.

| | |
|---|---|
| Deck-plate girder bridge | 100 + 9 l |
| " lattice " " | 100 + 8 l |
| Half through plate girder bridge | 300 + 12 l |
| Half through plate girder bridge, ties on shelf angle | 200 + 8½ l |
| Half through plate girder bridge with solid steel floor | 600 + 10 l |
| Riveted through truss bridge. | 400 + 6 l |
| " deck " " ties on top chord | 200 + 7 l |
| Through pin bridge | 400 + 5½ l |
| Deck pin bridge with stringers | 400 + 6 l |
| Deck pin bridfie ties of top cord | 300 + 6 l |

RAILROAD TRESTLES.

Loads as above.

Weight of spans as above.

" bents and bracing = 9 lb. per square foot of side profile, from ground to base of rail.

ELECTRIC RAILROAD BRIDGES.

To carry 25 ton cars, or 2,000 lb. per lineal foot of tracks, units 10,000 lb. and 12,000 lb. per square inch.

Weight of steel per lineal ft. of single track bridge are for

| | |
|---|---|
| Beam bridges | 50 + 5 l |
| Deck plate girder bridges | 50 + 4½ l |
| Pony truss bridges | 250 + 1.5 l |
| Through truss bridges | 250 + 1.3 l |

ELECTRIC RAILROAD TRESTLES.

Weight of spans as above.

" bents and bracing = 6 lb. per square foot on side profile, from ground to base of rail.

HIGHWAY BRIDGES, WITH WOOD FLOORS.

Dead weight of floor = 40 lb. per square foot. Live loads, 100 lb. per square foot, and units 10,000 lb. and 12,000 lb. per square inch.

Weights are per square foot of floor, and include steel only, without joists.

| | |
|---|---|
| Girder bridge with sidewalks | 3 + [illegible] |
| " " without sidewalks | 3 + [illegible] |
| Truss " with sidewalks | 3 + [illegible] |
| " " without sidewalks | 5 + [illegible] |

HIGHWAY BRIDGES WITH SOLID FLOORS.

Dead weight of floor = 150 lb. per square foot.

| | |
|---|---|
| Deck-plate girder bridges | 3 + [illegible] |
| Half through bridges | 3 + [illegible] |
| Truss bridge | 3 + [illegible] |

In the above l represents the length of span in feet, centre to centre of bearings.

## TESTS OF JOURNAL BEARINGS.

Professor R. B. Owens, of the electrical department of McGill University, Montreal, and Mr. J. B. Ingersoll, E.E., chief inspector of rolling stock of the Montreal Street Railway, have just completed some interesting experiments with a new roller bearing designed for all kinds of vehicles, from railway coaches to vehicles for ordinary street traffic. Street cars on the St. Catherine street route from Maisonneuve to Westmount were used, and the object was to show how much electrical power could be saved by the new device when contrasted with the journals at present in use on the street railway cars. The street cars are at present equipped with the standard journal bearing, and the journey of 10 6-10 miles covered with a large number of street corner stops consumed 15,200 watts, or 20.37 horse power, while the Wright roller bearing journal consumed 10 1-20 watts, or 13.43 horse power. The two cars used were alike and were loaded to represent 42 passengers. The testing instruments used were Thompson-Houston recording wattmeters.

# TELEGRAPH and TELEPHONE

## THE DYNAMO IN RECENT TELEPHONE PRACTICE.

An inspection of a modern telephone exchange reveals many interesting departures from the standard practice of a few years ago. This is especially true of the latest development in the telephone field, the central energy of common battery system. In this method of operating an exchange the subscribers' local battery and calling generator are dispensed with and the energy necessary for the signaling and talking currents are supplied by a suitable plant of the central office and distributed throughout the system. In an exchange, therefore, of any reasonable size the amount of power to be continuously taken is much greater than is usually supposed to be necessary in telephone work; hence it is a matter of considerable importance when remodeling or equipping new systems to give the most careful consideration to the generating devices and to arrange it in accordance with modern engineering practice.

Most of the generating apparatus required for modern telephone work is distinctly special in character, and cannot be purchased in the local market. A description, therefore, of apparatus which may be considered standard for supplying exchange systems, its location and the most desirable arrangement of circuits, will, no doubt, prove of interest to those engaged in the telephone field.

Considering, first, the source of direct current for transmitter service, the storage battery has been and is still very largely employed. Its low internal resistance, high e.m.f., compactness and great current capacity render it particularly well adapted for common battery service.

Fig. 2 shows a good arrangement of circuits using storage battery in duplicate, with means for charging furnished by a dynamo of the ordinary description. It will be noticed that one set of batteries is continuously on the system while the other set is being charged; all necessary connections between the lines, batteries and the charging mains being effected by means of double-throw, double-pole switches so arranged that there is no danger of interrupting the service.

It is of vital importance that storage batteries of whatever make or description have systematic and intelligent care. If properly installed and attended to they give excellent service at a moderate expense, but if from any cause deterioration of cells once sets in, effective service will be impossible, and the life of the batteries will be greatly shortened, to the discredit of the storage battery rather than the management, which in nine cases out of ten is responsible for such a result.

The proper care of storage cells, the location and cure of their troubles can only be learned by practical experience, and only men who have had the training should be put in charge of this important part of a modern exchange equipment.

The charging machine is usually of the shunt-wound type, wound for a maximum pressure of about thirty-five volts. If for any reason a compound-wound machine is used, means should be provided for shunting the series winding while the cells are being charged, the charging pressure being regulated in the usual manner by a shunt field rheostat as shown.

Both gas and gasoline engines have been used with success for operating charging dynamos where the local condition allow of their use. But as exchanges are often built in residental districts, it may be found necessary in some cases to drive by electric motor and thus avoid a frequent source of complaint where gas engines are used.

When only one set of storage batteries is used, or where it is intended to operate a system directly from the dynamo, the selection of a suitable generator for this service is a matter of great importance, and telephone engineers should not be misled by the idea that the ordinary bi-polar and multi-polar design, however successful it may be for lighting and power purposes, will be suitable for telephone work. While the current they generate is direct, it is not of a sufficiently steady character for transmitter service.

Modern dynamos are built with slotted core armatures and a high-field density. This, with the high self-induction and comparatively few number of coils in the armature, combine to produce a current which is so noisy in the telephone circuit as to make intelligible conversation impossible; no better proof of this can be furnished than listening on a telephone circuit subject to leakage and excessive induction frequently found on telephone systems. In these cases the disagreeable hum and buzzing of railway and lighting circuits is a serious hindrance to conversation, and if this is the case with the comparatively feeble currents induced in such a circuit, it can be readily seen that a machine of this type feeding a telephone system directly is out of the question, and no arrangement of choke coils and condensers will remedy or remove this defect.

A dynamo for direct service or for use in multiple with storage batteries must deliver a current perfectly free from pulsation, and the commutator and collecting device must be of such a character as to eliminate any possibility of imperfect contact at this part of the machine. These desirable results can only be reached by having a machine designed especially for telephone service.

It is of the multipolar type, the armature is smooth or surface wound with a great number of coils of only one turn each, and connected to a commutator having an equally large number of segments. The induction in the field is comparatively low, and the pole shoes are so shaped that any given coil enters the field in a very gradual manner regardless of the speed at which the armature is running. The brushes are of finely woven copper wire so that perfect contact is obtained at all times with the commutator, and the very slight pulsations in the current are so rapid in character as to be inaudible.

With this machine a very slight whistle is noticed at times, which is due to the action of the brushes on the commutator, and which is entirely corrected by impedence or choke coils.

The dynamo has become practically a standard with several leading telephone companies and solves quite a serious problem in the power equipment of most common battery systems. The largest size known to the writer is of ten-kilowatt capacity, which is in use in several of the exchanges of one of the leading sub-companies. A smaller size very much in demand is

rated at three-quarters kilowatt, delivering a current of twenty amperes at thirty to thirty-five volts.

In some cases, when used in connection with storage batteries, these machines are compounded, provision being made for short-circuiting the series coil when batteries are being charged; at other times the dynamo feeds the circuits directly. A machine of this sort renders unnecessary the use of a spare or duplicate set of storage cells, or where power can be obtained at all times, the cells may be dispensed with entirely.

Referring again to Fig. 2, the storage batteries in two equal groups, Nos. 1 and 2, are connected to independent double throw switches. The generator, G, is a plain, shunt-wound machine, with a field regulating rheostat, R; the latter should have a large number of contacts so as to give the closest regulation and should have sufficient resistance to give a suitable variation of pressure at the dynamo terminals.

The dynamo leads are connected to a main double-throw switch, as shown. This switch in one position will connect the dynamo to the battery charging mains, and when thrown to the lower position will be connected directly to the main telephone bus-bars, so that if the

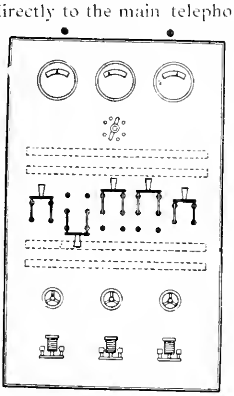


Fig. 1.

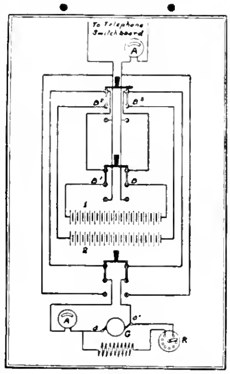



Fig. 2.

machine is of the noiseless type it may be used in case of accident to the battery system to support the telephone circuits directly. As arranged in this diagram the battery switches when thrown to their upper contacts will connect the battery to the charging dynamo, and when thrown down will be connected to the telephone mains.

An ammeter should invariably be used on the dynamo circuit, and in the telephone mains. It is also convenient, though not absolutely necessary, to have one in each of the battery circuits.

A voltmeter with a suitable switch should be arranged so that the pressure can be taken from A, A1, B, B1, B2, B3. It is essential for good service that the ammeters and voltmeters should be standard and of first-class construction. A low-priced instrument usually proves a very costly investment in the long run, as the readings, not any too accurate at first, soon show such a large error that they are practically worthless and liable to lead to serious results, especially when used with storage cells.

Referring to Fig. 1, in which the details of the switchboard are shown, this arrangement has proved very satisfactory in practice, and as here illustrated, corresponds to the system shown in Fig. 2; the voltmeter switch being placed in the center with the dynamo and main circuit ammeters on each side. The double-throw dynamo switch is in the center with the double-throw battery switches on either side.

One of the two smaller switches shown at the outside of the board is used for the motor switch when the generator is motor-driven. The other switch at the opposite side of the board is for connecting in the ringing or pulsating current generator.

Immediately below the main dynamo switch at the center of the board is the field regulating rheostat for the charging dynamo; while the small rheostats at either side control the motor and ringing generator, respectively.

Circuit breakers at the lower part of the board are shown, and it will be found in practice that automatic circuit breakers of standard make are much to be preferred to the uncertain and unsightly fuse.

The switchboard should be made of the best quality of slate, free from veins, if possible, and filled by driving paraffine into the pores of the stone by means of a gas torch and blow-pipe. This precaution is quite necessary where good insulation is required, as in a switchboard of this character 500 volts is quite frequently used to operate the motors and motor generators.

A very frequent error in erecting a switchboard is placing the board too close to the wall or partition. It should stand out as far as possible, with plenty of room and light for making connections, inspecting and cleaning the back of the board. The connections to the bus-bars, switches, etc., should be most thoroughly soldered or connected by heavy well-fitting bolts.

Considerable energy is frequently lost by imperfect contacts, and it should not be forgotten that the small area of contact or conductor necessary to carry the currents formerly used for telephone work are totally inadequate for the proper handling of large currents used in the common battery systems.

It is to be regretted that the manufacturers of storage batteries are so interested at the present time with light and power equipments that very little information regarding the storage battery as applied to telephone service is available for the telephone engineer. Descriptive bulletins without number of central station and isolated lighting plants may be had for the asking, but so far as the writer knows, nothing relative to telephone service has been published.

It is possible, however, that the fault is not altogether with storage battery manufacturers, but partly due to the reluctance of telephone companies to publish their plans of installation. This antiquated policy on matters of general interest to the profession is to be deplored. It has been abandoned to a great extent in the other branches of engineering, and there is no good reason for its continuance in telephone practice.

When noiseless dynamos of proper construction are used one of the batteries may be dispensed with to advantage, and the dynamo and central battery run in multiple, provided proper arrangements are made to take care of the increased pressure required during the period of charging.—D. M. Bliss, in Electrical World and Engineer.

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The big telegraph suit of Morrow vs. the Great North-Western Telegraph Company and the Western Union Telegraph Company, to annul the lease of the Montreal Telegraph Company's lines by the G.N.W. Company, has been settled out of court, in favor of the defendants, after over a year of litigation. Each side, it is understood, will pay its own costs.

## SPARKS.

The village of Strathcona, N.W.T., will probably install an electric light plant.

A by-law has been carried to have the streets of Embro, Ont., lighted by electricity.

McArel Bros., of Glace Bay, C. B., are installing an electric light plant of their own.

Cruise & Cummings, electricians, Sydney, N.S., have been succeeded by A. W. Cruise.

The Kootenay Electric Supply & Construction Company, Nelson, B.C., has been dissolved.

The ratepayers of Thessalon, Ont., have voted in favor of installing a municipal electric light plant.

The town of Blenheim, Ont., has just taken tenders on the installation of a municipal electric light plant.

A movement is on foot in Victoria, B. C., to have the telephone and electric light wires placed underground.

The capital stock of the Plessisville Electric Company, of Plessisville, Que., has been increased to $60,000.

The Sarnia Electric Street Railway Company are still considering the extension of their road to Point Edward.

A by-law to purchase the electric light plant for $27,000 was carried by the ratepayers of Parry Sound on May 6th.

The Kay Electric Dynamo & Motor Company, Limited, of Toronto, has been incorporated, with a capital of $40,000.

A by-law to raise $8,000 for electric lighting purposes was defeated by the ratepayers of Strathcona, N.W.T., recently by one vote.

Stayner, Ont., is looking into the question of developing the water power of the Nottawasaga river for the production of electricity.

A by-law will be submitted to the ratepayers of Brockville, Ont., to provide money with which to improve the electric light and gas plants.

The municipal power plant for the town of Orillia, Ont., is at last nearing completion. According to report, the work will be finished within a month.

Midland, Ont., is considering municipal control of electric lighting. A by-law to take over the present plant will be submitted to the ratepayers.

The Slade Electric Company, of Quebec, have been awarded the contract for wiring for electric light the grain elevator of the Quebec Terminal Company.

It is stated that a rival concern is preparing to submit figures for lighting the streets of Portage la Prairie, Man., in opposition to the Central Electric Company.

The ratepayers of St. Mary's, Ont., will vote on a by-law on July 8th to provide $15,000 for the extension and improvement of the waterworks and electric light plants.

The Peterboro Hydraulic Power Company are about to build a dam and develop electric power to be supplied to the American Cereal Company and other concerns.

The Emerson Incandescent Light Company, of Ottawa, has been incorporated, with a capital of stock of $800,000, to manufacture light, heat and power apparatus, etc. The provisional directors include V. L. Emerson, S. R. Poulin and Leopold Meyer, all of Ottawa.

Members of the Vancouver city council recently visited Seattle, Wash., in search of information upon the subject of municipal electric lighting. The British Columbia Electric Company, by whom the lighting is now done, charges $1.78½ per arc light per week, while the Stave Lake Power Company, a concern just organized, have made an offer of 90 cents per arc light.

The town council of Goderich, Ont., have accepted a proposition made by the Maitland River Power Company to deliver to the town for ten years from the date of installation of their plant the power necessary to run the arc and incandescent lighting systems and for pumping water supply at the following rates: The first 200 h.p., 24 hour day, at $30 per h.p. annually, used or unused; the next hundred h.p., 24 hour day at $25 per h.p. per annum; the next hundred, 24 hour day, at $23 per h.p. per annum; price per h.p. over that amnunt to be regulated by arbitrators chosen by the council and company. The council to grant the right of carrying line of transmission alone the municipal thoroughfares.

A bill regarding the inspection of steam boilers is now before the British Columbia legislature.

The Galt Gas & Light Company have been awarded a five year contract for lighting the streets of Galt, Ont.

The Chambers Electric Light & Power Company, of Truro, N.S., have installed two new dynamos of 1,200 capacity each.

The town council of Pat Portage, Ont., have made the Citizen Telephone & Electric Company an offer of $30,000 for their plant.

The contract with the Lachine Rapids Hydraulic & Land Company, by which Westmount, Que., is lighted, will expire in December next, and the citizens are discussing the advisability of installing a municipal plant.

Although the contract for electric lighting the streets of Montreal does not expire for about two years, the city council are now inviting tenders for a renewal of the contract. The tenders are to be received by June 15th, and to be accompanied by a cheque for $50,000.

A meeting of delegates representing the Electrical Worker's Union, of London, Hamilton, Brantford, Montreal, Toronto and St. John, N.B., was held in Toronto a fortnight ago. Two delegates were appointed to attend the annual convention of the International Union in St. Louis, Mo., next October, and it is understood that the question of shorter working hours was discussed.

The Applied Science Society of McGill University, Montreal, have elected the following officers for the session of 1901-02: President, C. M. Campbell, '02; vice-presidents, J. N. Hicks, '02, and H. P. Borden, '02; secretary, Jas. C. Ross, '03; treasurer, O. Hall, '03; second year representatives, E. J. Carlyle, '04, and G. O. McMurtry, '03; reporters, H. Biggar, '02; F. E. Sterns, '02; C. Rowlands, '03, and J. Egleson.

Mr. William M. Doull, secretary of the Cuban Electric Company, returned to Montreal last month from Havana, where Canadian capitalists are building an electric railway. Mr. Doull was in Havana when the first section of the road was opened for traffic. The first start made was on ten miles, and the company found their cars insufficient to accommodate the crowds which wished to avail themselves of the new system of travel.

The Almonte Electric Light Company have refused the offer of $10,000 made by the town for the purchase of their electric light plant. At a recent joint meeting of the council and members of the company, the company agreed to withdraw the suit to quash the electric light by-law, each party to pay its own costs. An attempt will now be made to arrange a price for the plant, and in case of failure within thirty days, arbitration will be resorted to.

Recently the city council of Belleville, Ont., invited tenders for lighting the streets and public buildings of the city. The competitors were the Trenton Electric Company and the Belleville Gas Company. The tender of the former company was accepted. They agree to furnish 30 arc lamps of 2,000 candle power, and as many more as may be required during the contract, at $58 per year; also not less than 200 incandescent lamps of 32 candle power at $10 each per annum. Private consumers to be supplied at rates varying from $7.25 per lamp up to five lamps, down to $2.50 for 30 lamps or over. The contract is for five years.

The Bridgetown Electric Light, Heat & Power Company have secured a contract with the town for lighting the streets for five years. The contract calls for thirty-five 32 candle power lights, and for an all night service at the price of $20 per light per year. The contract also fixes a schedule for private lighting within the town: 16 c.p. house lights up to five lights, are rated at 1½c.; five to ten lights, 1¼c.; and over ten, 1 cent per light. 12 c.p. lights will cost 1¼c. up to five, and over that, 1 cent per night. Store lights, 16 c.p. will be charged at 2c. per light up to ten lights, and 1¾c. for more than ten. Church lights are to cost not more than $1.50 per light per year. The all night service is to go into effect not later than August 1st, 1901.

At a recent session of the Nova Scotia legislature the following acts were assented to: To enable the town of Lunenburg to borrow money for water, electric light and sewerage purposes; town of Annapolis Royal, to borrow money for electric light purposes; town of Parrsboro, to borrow money to extend their electric light plant; town of New Glasgow, to borrow money to provide a fire alarm system; to incorporate the Bedford Electric Company, Limited, Nova Scotia Electric Light Company, Limited, Oxford Electric Company, Limited, Mahone Bay Electric Light & Power Company, Limited, Blockhouse Electric Light & Power Company, Limited, Eastern Telephone Company, Limited, Valley

Telephone Company, Limited; and an act respecting the Chambers Electric Light & Power Company.

Mr. J. H. Jewell, of Toronto, is negotiating for the establishment of an automobile factory at London, Ont.

The ratepayers of Thorold, Ont., will vote on a by-law on May 13th to provide $6,000 for the extension of the electric light plant.

The city of Winnipeg is about to invite tenders for the supply of fifty arc lamps. It is probable that another dynamo may be purchased.

Mr. Joseph Barrett, who has the contract to supply Toronto Junction with electric power, is said to have sold out to the Humber Power & Light Company.

Last January Mr. Thos. Welsh, of Hensall, Ont., bought the electric light plant from Mr. H Cook. He has built a new power house, brick and stone, 36 x 40 feet, and installed new Bell engine and Leonard boiler, heater and steam pump. He has a 60 k.w. inductor alternator of the United Electric Company's build, with E.B.T. exciter and marble switchboard complete. He has also installed 300 light capacity in Packard transformers, type L, and built new main wires. He is installing more lamps right along and hopes to reach 1000 by fall. The whole plant was installed by and is now in charge of Mr. J. H. Ward, late of Exeter, and is giving thorough satisfaction.

## PERSONALS

Mr. M. J. Kennedy has been appointed superintendent of the Montreal street railway, to succeed Mr. Duncan McDonald.

Mr. J. W. Marr, of Toronto, has been appointed superintendent of the power house of the Niagara Falls Park and River Railway.

Mr. Wm. N. Campbell, formerly with Messrs. J. D. McArthur & Co , of Toronto, has recently accepted the position of travelling representative in Ottawa of the Reeves Pulley Co., Toronto.

Mr. Harry Rolfe, of the International Correspondence Schools, Scranton, Pa., has accepted an important position in the mechanical engineering department of the Westinghouse Electric and Manufacturing Company, Pittsburg, Pa.

Mr. Charles L. Farrer, of Parry Sound, Ont., who has lately been in the employ of the Lachine Rapids Hydraulic & Land Company, of Montreal, has been appointed superintendent of the Canadian Electric Light & Power Company's plant at Chaudiere Falls, Que.

Mr. William C. Hubbard, representative of the Manhattan General Construction Company, with offices at 11 Broadway, New York, recently visited Toronto, Montreal, Ottawa, and other Canadian cities, In the interest of the Manhattan Company, which is giving increased attention to Canadian business.

The death is announced of Richard P. Rothwell, one of the founders of the American Institute of Mining Engineers, and for upwards of thirty years editor of the Engineering and Mining Journal. He was also a successful inventor on the line of mining apparatus and metallurgical process. Mr. Rothwell was a Canadian, having been born at Ingersoll, Ont., in 1837. He was educated at the Rensselaer Polytechnic Institute, the National School of Mines, Paris, and the Frieberg Mining Academy.

Mr. E. K. M. Wedd, purchasing agent of the Canadian General Electric Company, is now numbered among the benedicts. On April 26th he was united in marriage to Miss Mattie Garvin, of Brooklyn, N.Y. The event was made the occasion of the presentation, by the staff of the Canadian General, of a handsome cabinet and chair and a gold mounted umbrella, accompanied by an address expressing the esteem and regard in which Mr. Wedd is held by his confreres in the office. We join with their numerous friends in wishing Mr. and Mrs. Wedd many years of happiness.

## TRADE NOTES.

The Dodge Manufacturing Company, of Toronto, have in work a number of large friction clutch pulleys for the Smith's Falls Electric Light & Power Company.

The Goldie & McCulloch Company, of Galt, Ont., are supplying shaftings, pulleys, etc., for the new works of the Grey & Bruce Cement Company at Owen Sound, Ont.

Mr. Emerson McMillan, of New York, is said to be making arrangements to consolidate a number of gas light, traction and water power companies throughout the United States and Canada. The Jacques Cartier Water Power Company, of Quebec, is named as one of the companies to be included in the deal. The combined capital of the proposed corporation is about $35,000,000.

Our readers are asked to note the change of address in the advertisement of the Weston Electrical Instrument Co., from "114-120 William St., Newark, N. J.," to "Waverley Park, Essex Co., N. J."

The Northey Manufacturing Company, of Toronto, are constructing what will be the largest electrical single pumping engine in Canada. It is being built for the Montreal Water & Power Company, will have a capacity of 5,000,000 gallons every 24 hours, and will weigh 200 tons.

The Dodge Manufacturing Company, of Toronto, are installing the heavy jack shaft of hammered steel, floor stands with ball and socket, self-oiling pillow blocks, large split pulleys, couplings, etc., for the new power plant of the Lincoln Electric Light & Power Company, of St. Catharines, Ont.

Education has always hitherto been regarded as the peculiar privilege of youth. If anyone was compelled to leave school insufficiently trained for the work of life, his case was commonly supposed to be beyond remedy. Hence, until the International Correspondence Schools, Scranton, Pa., were established, no attempt had ever been made to reach men and women engaged in earning a living, with an organized course of study intended to fit them for higher efficiency in their chosen pursuit, or to train them for another. The Schools are now doing this important work for thousands in middle life and beyond. Such as these value educational opportunities most highly and know exactly what they want. "Success that comes after many years is the best."

The Packard Electric Company, of St. Catharines, announce that, owing to ill health, Mr. E. E. Cary has resigned his position as manager of the company, which position has been accepted by Mr. R. B. Hamilton, who, during Mr. Cary's illness of the past two months, has been acting manager. The company state that Mr. Hamilton's technical education and practical experience are a guarantee that the excellence of the Packard product will be fully maintained and advanced, and important improvements have already been inaugurated, with most satisfying results. Mr. Geo. A. Powell, who has been absent for the past four months, has returned, and will assume the management of the sales department.

The S. Morgan Smith Company, of York, Pa., have recently installed the heaviest pair of water wheels that has ever been built in America. They are of the McCormick type, 54 inches, each in a separate iron case, discharging into a cast iron chest and draft tube. The power is used for operating a large air compressor and generator in the power plant of the Boston & Montana Consolidated Silver & Copper Mining Company, of Great Falls, Mont. The outfit weighs 300,000 pounds, not including the power connections, draft tubes or supply pipes. The wheels were tested at the Holyoke testing flume, and are said to have shown an extraordinary efficiency, developing 2,800 h. p. under a head of 40 feet. The speed is controlled by type "B" Lombard water wheel governors. The gates are so accurately balanced that one man can operate the gates of both wheels with ease. The S. Morgan Smith Company have lately completed additions to their works, and have the largest and one of the most complete water wheel plants in the world. An illustration of the turbine in the Boston & Montana Mining Company's plant is shown in their advertisement on another page.

## NATIONAL ELECTRIC LIGHT ASSOCIATION.

The annual convention of the National Electric Light Association of the United States will be held at Niagara Falls, N. Y., on the 21st, 22nd and 23rd inst. For three days previous to and following these dates, the railways on both sides of the line will grant to delegates to the convention a transportation rate of a fare and a third on a certificate plan.

The Niagara, St. Catharines & Toronto Electric Railway Company is announced to have purchased the Port Dalhousie, St. Catharines & Thorold Electric Street Railway from Messrs. Dawson & Symmes, of St. Catharines. The road runs from St. Catharines to Thorold and was one of the first electric street railways built in Canada. The purchase price is given as $90,000. The road will be put in first class condition, with improved roadbed and new rolling stock.

# ENGINEERING and MECHANICS

## CONDENSATION IN STEAM PIPES.

W. H. WAKEMAN, IN THE ENGINEER.

As soon as steam leaves the boiler in which it is generated, it begins to go back to water, so that the intelligent engineer is constantly watching for improved methods for preventing condensation before it is wanted. It is not the object of this article to describe plans for accomplishing this desirable object, but to show how much steam is condensed in pipes under given condition, for there is not as much available literature on this subject as there should be.

Experiments made by reliable parties several years ago, which are as valuable now as when first made, show that a very little change in the conditions make a considerable difference in the results obtained. Putting the results together and taking the average of them shows that when the number of square feet of pipe surface exposed to still air is multiplied by the difference in temperature between the air to be heated and the steam inside of the pipe, and the product divided by the number of pounds of water obtained per hour by condensation, the quotient is practically 420. This result has been accepted as reliable for a long time, so that a rule for determining the amount of condensation in pipes, based on these results, is as follows: Multiply the number of square feet of pipe surface by the difference in temperature between the air in the room and the steam in the pipe. Divide the product by 420 and the quotient will be the pounds of steam condensed into water per hour.

For example, suppose that we have 300 square feet of pipe, carrying 90 pounds pressure, in air at 50 degrees f. The temperature of steam at 90 pounds is 331 degrees, making the difference 331 − 50 = 281. Then 300 × 281 ÷ 420 = 200 pounds of water per hour.

As before mentioned, this rule is based on favorable conditions, which means that the air was nearly still. When the air is in motion the condensation will take place much faster, so that it becomes difficult to determine just how much it is except by direct experiment.

This fact has become much more prominent since the forced blast system has become popular for heating and ventilating. It is customary to multiply the results obtained by the foregoing rule, by a factor which varies from 2 with gentle circulation to 5 with a rapid movement of the air. Which shall be used must be determined by the engineer according to his best judgment.

In some cases it is necessary to carry steam for a long distance, and it is desirable to know how much the loss will be under given conditions, for if it promises to be excessive the necessary provision must be made for it.

In a letter to The American Machinist, F. A. Nystrom gives the details of observations made to determine the amount of water resulting from condensation of steam in pipes exposed to the outside air without protection of any kind; 217 feet of 8-inch pipe, 219 feet of 7-inch, and 258 feet of 6-inch were put up with so much pitch that all of the water traveled to the end of the system, where it was caught and weighed. Assuming that all of this pipe was ¼-inch thick, there were 483 square feet of the 8-inch, 430 of the 7-inch and 438 of the 6-inch, making a total of 1,351 square feet. The pressure was 90 pounds, the temperature of which is 331 degrees f., and the plant was located where the outside temperature did not vary much from 64 degrees f., so that the difference was 267 degrees.

Under these conditions the condensation amounted to 1,440 pounds per hour, and as the test lasted for twenty days, there is much less chance for securing unreliable results than if it was for one day, or perhaps a few hours only.

Now, when we proceed as in the first rule illustrated and explained, we have 1,351 × 267 ÷ 1,440 = 250, which shows that in order to determine the amount of condensation in steam pipes that are exposed to the outer air, which means that they are not protected from the weather, we may proceed as follows: Multiply the square feet exposed to the air by the difference between the temperature of the steam and the outer air, and divide by 250. The quotient will be the pounds of steam condensed per hour.

This experiment was carried further, making it still more valuable, for the pipe was covered with a fairly good nonconductor of heat and the results obtained for another period of 20 days were carefully noted. The total condensation was now reduced to 195 pounds per hour, and when we multiply 1,351 by 267 as before and then divide by 195, the quotient is 1,850. From this we may formulate a rule for determining the weight of steam condensed in well covered pipes, as follows: Multiply the number of square feet on the surface of the pipe by the difference between the temperature of the steam and the air, and divide by 1,850. The quotient is the pounds condensed per hour. In this case it is 1,351 × 267 ÷ 1,850 = 195 pounds per hour.

Right here I wish to insert a few lines about rules and formulas. The man who believes that rules which are printed in a mechanical paper or in a book, are written by somebody who really knows nothing about the subject, is occasionally in evidence even at this enlightened period of the world's history, therefore he believes in nothing but what is the direct result of some of his own practical experiments. This type of man is not wholly useless, because he keeps some of the rest of us from becoming too theoretical, but I wish to call his attention to the fact that the rules which I have given are based directly on the results obtained from experiments, and are as simple and as practical as the process of putting a load of coal on the scales and weighing it. In a great majority of cases the rules found in standard works are based on practice, and where they do not seem to apply to a given case, it is usually because some of the conditions do not agree with those under which the rules were formed.

The saving made by covering this pipe is worthy of a passing notice. In the first case the condensation was 1,440 pounds per hour, but in the second case it was reduced to 195 pounds, a difference of 1,245 pounds. If the hot water was not used for some good purpose the heat required to evaporate it was lost and coal was wasted accordingly. If the boiler evaporated 8 pounds of water for each pound of coal burned under it, then it required 1,245 ÷ 8 = 155 pounds of coal per hour, or 1,550 pounds per day of 10 hours, and this was a total loss.

## WATER AS A LUBRICANT.

Mr. D. R. Munro, of Wolfville, N.S., at the request of a St. John engineer, furnishes the following account of his experience in running an engine with water as a lubricant: I have been running our 125 h.p. Leonard Peerless Compound Engine (self-oiling type) for over five months with nothing but water to lubricate the main working parts. It came about partly from experiment and partly from necessity, being short of oil at the time. The results have been most remarkable and satisfactory. Before using water I was obliged to adjust the engine occasionally particularly the wrist pin, quite frequently (which is a weak point in any engine). Now since water has been used as a lubricant there has been no adjustment whatever for five months, and to-day the engine is running perfectly, although very heavily loaded. I am quite sure the idea is entirely original, and anyone using water instead of oil in this type of engine will never use oil again, as water is so much less trouble. When using oil I found that the churning it got caused it to disappear in the form of vapor, I suppose. This is how I began to use water to raise the oil in the reservoir after it had become so low that the crank discs would not touch it. I kept on adding more water when necessary, until the oil entirely disappeared add left nothing but water. Another good feature is that while oil continues to grow less, the water, on the other hand, accumulates, due to drip from piston rod, so there is no possibility of the engine running dry. I was somewhat anxious about rusting at first, but find all the parts remained perfectly clear and bright.

A local company has been organized at Cranbrook, B. C., for the purpose of installing telephones.

Messrs. Ness, McLaren & Bate, of Montreal, have made extensive improvements to the telephone exchange at Pontiac, Que.

The Bell Telephone Company are understood to have made an offer to purchase the interests of the Victoria County Telephone Company, of Lindsay, Ont.

The Nova Scotia Telephone Company are negotiating for the acquisition of the property and franchise of the Eastern Telephone Company, whose lines extend to Baddeck.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. XI. JUNE, 1901 No 6.

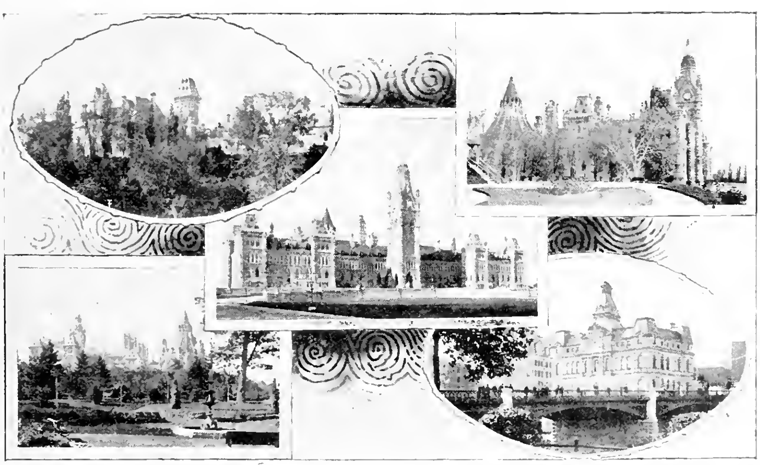
# Canadian Electrical Association Convention

## Ottawa, June 19th to 21st.

The forthcoming convention of the Canadian Electrical Association, to be held in Ottawa, should be attended by every member and person interested in electrical progress. It promises to be both profitable and pleasurable, and should easily establish itself as the banner convention of the Association. Nature must have anticipated such a gathering, for she has dealt out to the Capital city with lavish hand that which will make it interesting at once to the practical electrician and pleasure seeker. No where else on the continent can such a happy blend be found. Electrical development in and about the city of Senators has given it a prominence second only to that centering on its stately Parliament Hill, with its crown of imposing legislative chambers. The convention should be attended, no matter what the expense of time or money, as it is found to be brimful of practical pointers and pleasurable features.

To see is to appreciate, and cold type and illustrations can only give an odor of the essence of education and enjoyment in store for the wise electrician who makes the professional pilgrimage to his Capital City. Anyone of the score of attractions are alone worthy of a visit. The electric plants in and about the city should offer sufficient inducement, but the other sight-seers' magnets are bound to make the visit one of profitable pleasure.

Every effort is being put forth by President Dion and his fellow electricians to make the convention a book mark in the pages of the Association's history. To every visitor who hies himself to the annual re-union, is extended the freedom of the Capital, which has a history not the least of its interesting features. Beneath the shadows of Parliament Hill can be studied the passing ages of Canadian history arrested as it were for the visitor's eye. The locks of the Rideau Canal, Col. By's master piece, massive, quaint and grey with age, speak of the early days of the nineteenth century. Within view, the graceful lines of the new Interprovincial bridge tell of the opening days of the twentieth century. Contrast pleasing and interesting meets the eye on every side. A volume could in short be written on Ottawa, and still the tale would be but half told. Its University, Normal School, Convents and other seats of learning, the imposing French Cathedral, and friendly front of Christ Church Cathedral, its numerous beautiful churches and private residences, Rideau Hall, the home of the Governor-General, the stately Parliament Buildings, with their wealth of architectural beauty, all make it a city wherein the eye is pleased and the mind elevated. Its quaint and picturesque river scenes, bustling lumbering, electrical and manufacturing industries, the long lines of progressive, prosperous business and residental streets, the many delightful suburban haunts, its natural beauty must all be visited and studied if the Canadian is to truthfully say that he knows his own country. The electrician must visit the many centers of electrical energy in and about Ottawa if he is to say that he has seen the very latest appliances and equipments in his own special sphere.



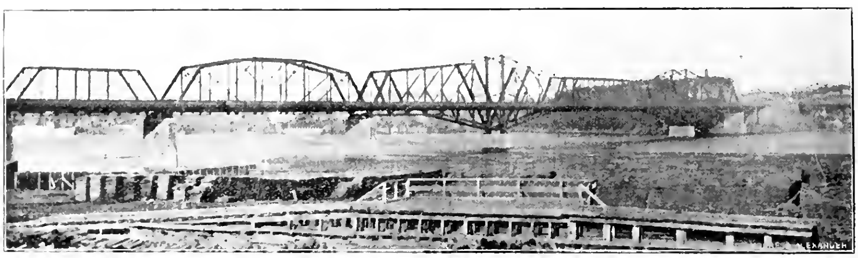
VIEWS OF PARLIAMENT BUILDINGS AND POST-OFFICE, OTTAWA.

The disastrous fire fourteen months ago made necessary the postponement of the convention, which was transferred last year to Kingston. Although Ottawa and Hull are

both building up well, the swath of the fire is still easily discerned, furnishing a vista of ruin seldom equalled in the history of the world's cities. With the energy characteristic of the Ottawan, the city has recovered itself and the latch key hangs in an inviting position for the convention visitor. The variety of attractions offered the visitor by Ottawa rivals those of the Old World's Capitals. A study of the accompanying illustrations will bear out this assertion.

The member of the Canadian Electrical Association who turns a deaf ear to his Capital's invitation, will not fail to hear of his folly when his more enterprising friends return.

Wellington Street, Ottawa, from Parliament Hill.



The New Interprovincial Bridge across the Ottawa River.

View of Rideau Street, Ottawa.

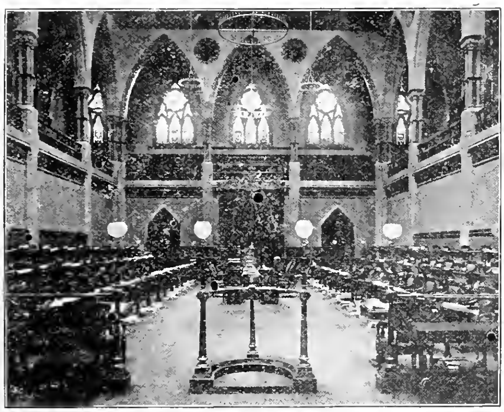
THE OTTAWA ELECTRIC COMPANY.

The Ottawa Electric Company was established in 1894, and is the fruit of the amalgamation of the three electric companies then in existence, viz., Chaudiere Electric Light & Power Company, Limited, the Standard Electric Company, Limited, and the Ottawa Electric Light Company. The present company supplies incandescent and arc lighting and power to Ottawa and vicinity. It has shown great energy in the extension of its system, and now reaches all parts of the city and suburbs, covering almost every street. In addition to the city contract for street lighting, which calls for 442 arc lights, the company supplies its private customers with 225 arc lights. The installation of incandescent lights is 100,000, over one and a half lights per head of population.

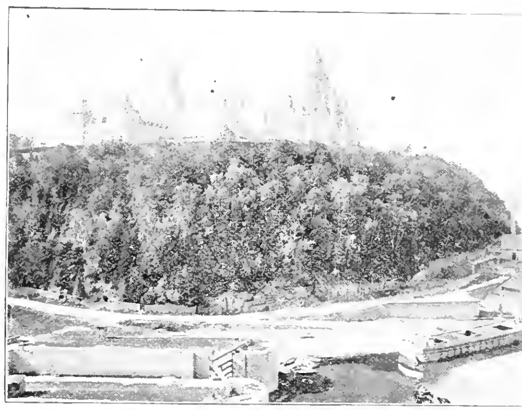
The company does not supply power in very large units, but operates some 300 motors, varying from a half to 50 h.p. Before the fire on April 26th, 1900, the company had six different power houses, but four of them were destroyed on that memorable day. Since then the company has shown wonderful energy in getting its service under way, by establishing temporary stations which will be used until the re-construction of the permanent plants.

The company took advantage of this forced re-construction to make such alterations in its system as would bring it up to the most exacting modern requirements. On the site of one of the old power houses, the company is

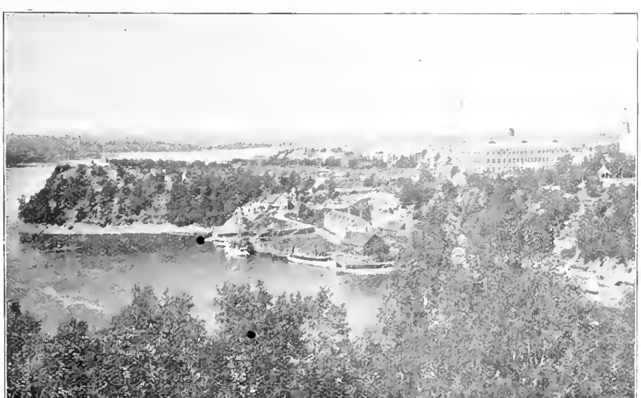
View of City from Rideau Falls.



Senate Chambers, Parliament Buildings.



View from Foot of Rideau Locks.

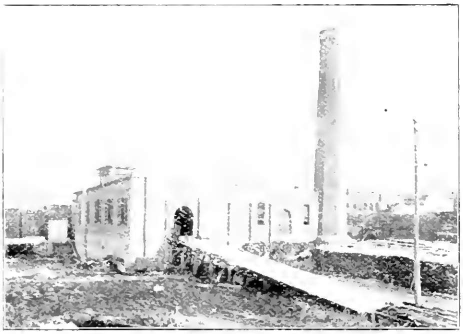


Nepean Point and Printing Bureau.

VIEWS OF OTTAWA AND VICINITY.

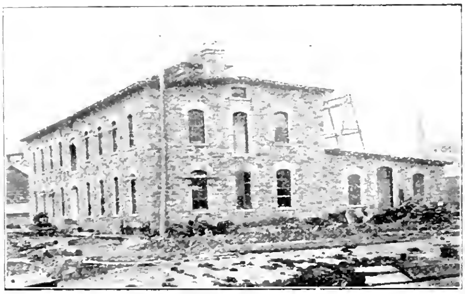
building a large hydraulic station. The two stations, one hydraulic and one steam reserve, which escaped the fire, are to be remodelled. The current generated in these three stations will be united in a distributing station up town, from which wires for all services will radiate.

The new station under construction will be absolutely fire proof, being built of concrete, brick and iron. From the bulk heads at the intake, the water will be carried



OTTAWA ELECTRIC COMPANY—EXTERIOR STEAM STATION, BRITANNIA STREET.

through a wooden box flume for 200 feet into a large pond, surrounded by heavy concrete walls. From this pond, it will pass through an iron rack into the flumes of the several wheels, to afterwards discharge through tubular iron draught tubes into a tail race cut out of the solid rock. This tail race will be about 30 feet in width, extending about 200 feet and discharging into the Ottawa river at a point about 1,000 yards below the Chaudiere Falls. The plant in this station will consist of three sets of horizontal water wheels made by the Stillwell Bierce & Smith Vaile Company, of Dayton, Ohio, direct connected to Westinghouse generators. Each unit will consist of three 39-inch wheels, two with central discharge and one with quarter turn, operating at a speed of 143 r. p. m. under 25 feet head. The wheel cases will be submerged in the flumes, the draught tubes being built in the floor. The



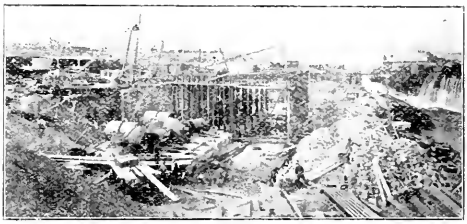
OTTAWA ELECTRIC COMPANY—EXTERIOR OLD HYDRAULIC STATION, AMELIA ISLAND.

generators will be of 700 k.w. capacity, two phase, 60 cycles, 2,200 volts. Extra flumes, draught tubes, etc., are to be provided, so that additional units can be installed any time without much trouble.

Two Westinghouse exciters, each 56 and a half k.w. and capable of supplying alone the fields of all the generators in the station, will be direct connected, each to a pair of 15-inch wheels, running at 475 r. p. m. Provision will be made against the possibility of such small wheels choking with frazil by means of pulleys placed on the adjoining main wheel shafts, from which the exciters may be driven when required. The water wheels will be governed by Lombard governors. A 20 ton travelling crane is being provided for handling machinery in this station. The building will be 150 feet long by 45 feet wide.

The old hydraulic station which escaped the fire, will be remodelled by discarding a number of small generators, both direct and alternating current, and a mass of shafting, pulleys, etc., and installing in their stead two generators similar to those in the new station, except that they will be belted to the jack-shaft of the water wheels and run at 375 r. p. m. The latter are vertical and bevelled geared. Provision will also be made for the installation of a third unit later. This building is a substantial stone structure, 145x50 feet and two storeys high, with flat gravel roof. The head of water at this station is 22 feet.

The steam power house, which contains two Wheelock engines of 500 h.p. each, tandem compound and condensing, will be re-arranged by changing the generators therein for two of the same type as in the other stations, but of 225 k.w. each. There is also in this station a 500 volt D. C. generator which is kept in reserve to help the street rail-

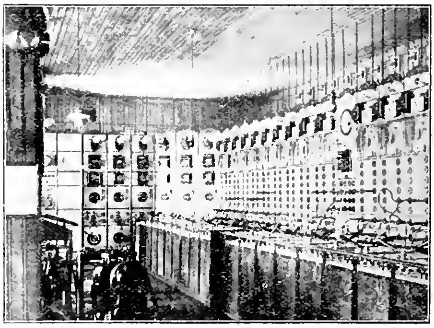


OTTAWA ELECTRIC COMPANY—NEW HYDRAULIC WORKS AND STATION IN COURSE OF CONSTRUCTION.

way company or the D.C. motor system of this company in case of any breakdown elsewhere.

The sub-station will contain, besides extensive marble switch-boards for the distribution of the different classes of service, a 300 k.w. rotary converter, supplying 250 and 500 volts D C. motor service on a three wire system for motors already installed, elevators and places where it may not be desirable to use A. C. two phase motors. A storage battery of 400 ampere hours capacity will relieve the "Rotary" during the peak at the load. There will also be three units, each composed of a 350 h.p. induction motor direct connected to two Western Electric multi-circuit arc machines, giving a capacity of 300 enclosed arc lamps per unit. Adams Bagnall arc lamps will be used.

The sub-station is to be a substantial brick building, and will contain besides the above, quarters for line men



OTTAWA ELECTRIC COMPANY—SWITCHBOARD (IN PART—) POWER HOUSE NO. 1.

and wire men. There will also be accommodation for line men's stores, workshop, meter department, etc.

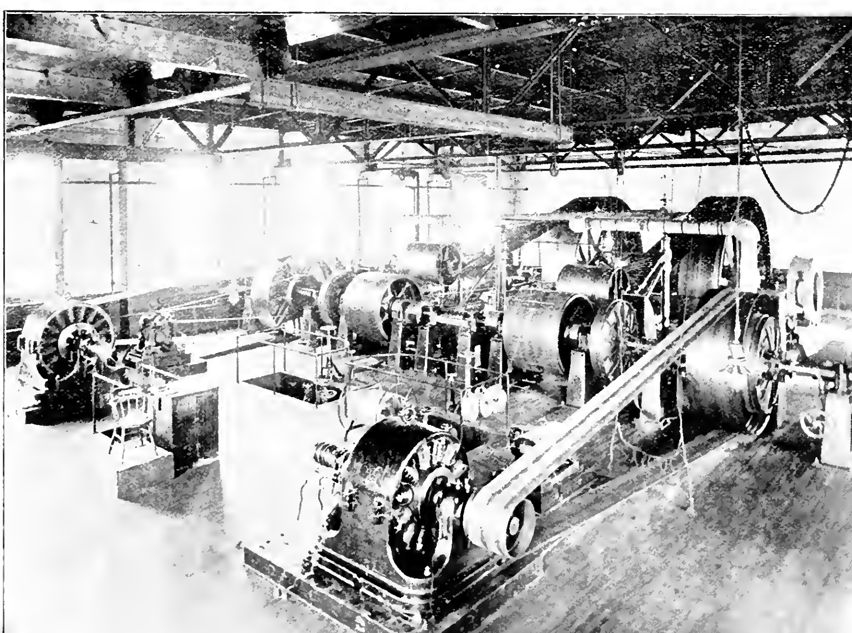
The company occupies handsome and commodious offices on Sparks Street near the Russell. The officers of the Ottawa Electric Company are as follows:—President, T. Ahearn; Vice-President, F. P. Bronson; General Superintendent, A. A. Dion; Secretary-Treasurer, D. R. Street; Superintendent of Power Houses, John Murphy; Superintendent of Construction, W. G. Bradley; Hydraulic Engineer, W. H. Baldwin; Steam Engineer, George Scott.

Mr. A. A. Dion, General Superintendent of the Ottawa Electric Company, is probably best known to his colleagues throughout Canada in his official capacity as President of the Canadian Electrical Association. Mr. Dion has been engaged in the electrical business in various positions for 12 years, having occupied his present position since the formation of the company in 1894. He is a member of the American Institute of Electrical Engineers and the Canadian Society of Civil Engineers. He is energetic, affable and thoroughly versed in all the details of the work. Capt. D. R. Street, Secretary-Treasurer of the Ottawa Electric Company, was treasurer of the Chaudiere Electric Company for three years prior to the amalgamation. He was then appointed Chief Accountant of the Ottawa Electric Company, and in 1895 entered upon his present responsible position. Capt. Street holds a commission in the Governor-General's Foot Guards, one of Ottawa's crack regiments. His enthusiasm in military matters and popularity in the city are both of a high voltage. Mr. John Murphy, Superintendent of Power House for the Ottawa Electric Co., is a young man for the position, but one well qualified if judged by the degree of excellency which the system has attained despite the serious set-back given by the fire of April 26th, 1900. Mr. Murphy is a graduate of the University of Ottawa. While at that University he paid special attention to the study of electricity. He was first connected with the local office of the Bell Telephone Company and afterwards accepted charge of an electric plant at Chelsea, one of first installed in the vicinity of Ottawa. Mr. Murphy was afterwards connected with the Chaudiere Light & Power Company, and on the amalgamation with the present company, he assumed the position he now holds. He was recently admitted into full membership in the American Institute of Electrical Engineers, a distinction and recognition of merit.

MR. A. A. DION,
Superintendent Ottawa Electric Company, and President C. E. A.

CAPT. D. R. STREET,
Secretary-Treasurer Ottawa Electric Company.

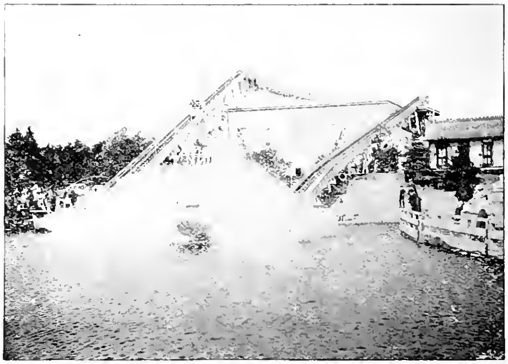
MR. JOHN MURPHY,
Superintendent of Power House, Ottawa Electric Company.



OTTAWA ELECTRIC COMPANY—INTERIOR STEAM STATION, BRITANNIA STREET.

Chats Rapids on Ottawa River.

Scene in Queen's Park, Aylmer.



Water Chute, Queen's Park, Aylmer, Hull Electric Railway.

Rideau Falls at Junction of Ottawa and Rideau Rivers.

Chaudiere Falls.

VIEWS OF OTTAWA AND VICINITY.

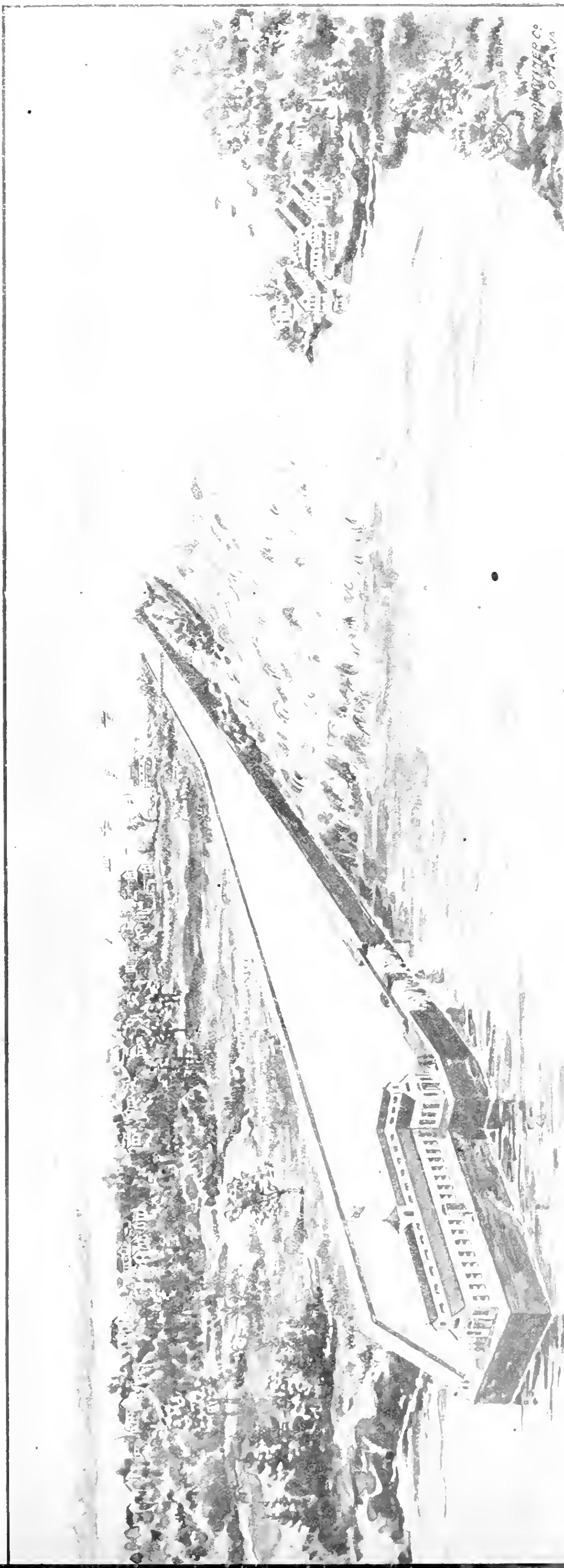
## METROPOLITAN ELECTRICAL COMPANY.

The delegates to the forthcoming convention will find in the Metropolitan Electric Company's works a striking illustration of the great strides made in the development of electrical power in the vicinity of Ottawa. The scene of operations is at Britannia, situated on the Ontario side of the Ottawa river about five miles from the Capital. Here are the Deschene Rapids, famous as a fountain head for the development of electrical energy. This water power at a comparatively small outlay can produce 20,000 horse power. It is to be taken by canal from still water at the head of Deschene Rapids, to still water at the foot; the fall in the water level being about ten feet. For thirty miles above, the current is hardly noticeable. The river is from one and a half to four miles wide, and very deep. The present canal, which is practically completed, has a length of 3,000 feet. At the mouth where the water is thirty feet in depth, it has a width of 240 feet. The narrowest part is 150 feet, and at the lower end the canal is 450 feet wide. Hence with a fall of ten feet, according to plans, it will be easy to develop 5,000 h.p. in this canal. The canal is cut in the solid rock for about one-half the distance from the mouth end. The inside wall for the balance of the distance is made from clay, riff raffed with rock taken out of the excavation. The outside wall is made of crib work. Work will shortly be started on the power house, which will be situated at the east end of the canal. The scene of the Metropolitan Company's operations were visited a year ago by the leading civil and electrical engineers of Canada, who were in attendance at the annual convention. They one and all when viewed by reporters, expressed themselves as having every covfidence in the future of the company. The power developed, they stated, will prove constant and adequate under all circumstances and conditions.

On this occasion, Prof. Bovey, of McGill University, Mr. E. P. Hanniford, Mr. Robert Forsythe, Mr. C. B. Leprohon, Mr. William Kennedy, of Montreal, Mr. Robert McCall, Provincial Engineer of Nova Scotia, Mr. C. H. Mitchell, of Niagara Falls, Mr E. H. Keating, of Toronto, and other equally prominent engineers assured the people of Ottawa through the local papers, that there is no probability of this power being impaired by anchor ice, and that it must prove an important factor in the industrial development of the city.

Prof. R. B. Owens, of McGill University, and Mr. C. K. Green, engineer of the Cataract Power Company, of Hamilton, have made special reports on this power to the same effect.

Nature assisted by man has solved the vexatious anchor ice problem for the Metropolitan Company. Where



Canal and Power House, Metropolitan Electrical Company.

there is still water for thirty miles, as above the power house, it freezes over and prevents the formation of anchor ice. Below the power house the river is frozen for a distance of three miles, and the water is very deep.

The Metropolitan Electrical Company has an advantage inasmuch as it has a constant supply of still water above the power house. It can thus be seen that the Metropolitan Company has an electrical power absolutely free from anchor ice, which is such a detriment to many electrical companies.

Power will be transmitted to Ottawa for lighting and manufacturing purposes, by means of transmission wires five miles long. The property at Britannia consists of 100 acres, so that there is ample accommodation for large manufacturers. The development of the power has been a great work, and the citizens of Ottawa and suburbs have abundant faith in its ability to bring increased industrial prosperity. The city council, as an evidence of this faith, granted the company a franchise which gives it power until 1923 to deliver and distribute electric power within the city limits for lighting and manufacturing purposes. It has thus a wide field, as the demand for and the use of electricity in the rapidly growing city is increasing at a great rate as the years pass by. The city has a population of over 85,000 within three miles of the city hall. It is served by eight lines of railway and hence should with the extra and effective advantage of cheap power, soon become one of the leading manufacturing centers.

The officers of the Metropolitan Electrical Company are as follows: President, Thomas Lindsay, merchant, Ottawa; Vice-Presidents, W. Arnold, Ottawa, and Charles Jenkins, Petrolia; Secretary-Treasurer, George A. Wanless, Ottawa; Directors, John Flett, Toronto, Arthur B. Broderick, Ottawa, Fred C. Cains, Montreal, and Edgar S. Reid, Toronto.

Mr. Lindsay, President of the company, though a comparatively young man, occupies a prominent position in the business field in Ottawa. He has outstripped many of his older competitors and is looked on as one of the shrewdest and most successful of Ottawa's merchants. He is head of the well known firms of T. Lindsay & Company and Larose & Company, conducting departmental stores on Wellington and Rideau streets. The list of shareholders includes many of Canada's leading financiers and business and professional men.

The Metropolitan works can be reached from the heart of the city by the Ottawa Electric Railway surburban line to Britannia on the bay.

MR. THOMAS LINDSAY, PRESIDENT METROPOLITAN ELECTRICAL COMPANY.

## OTTAWA ELECTRIC RAILWAY.

It is the proud boast of the people of Ottawa that their street railway system stands second to none in America, both in point of equipment and operation. The citizens take a great interest in this road; when an Ottawa man goes abroad he forms his opinion of a street car service by comparing it to that of his native place as a standard of excellence. The street railway interests of Ottawa are controlled by one company. The cars are operated entirely by electricity by the overhead trolley system, an the service is beyond question a good one; the road-bed is smooth and the cars are roomy and comfortable. cars are pleasantly heated in winter by electric heaters concealed under the seats; they ride easy, are kept neat and clean, and the conductors and motormen are well dressed and well disciplined. The cars go everywhere and everybody rides.

The Ottawa Electric Railway Company is not an old corporation. In 1890 the city council granted Messrs. Ahearn and Soper a franchise for operating an electric road. They organized the Ottawa Electric Street Railway Company, which was incorporated early in 1891 with an authorized capital stock of $1,000,000, and in June of that year the road was opened for traffic. The Ottawa City Passenger Railway Company incorporated in 1865, had been in operation since 1870. In 1893 these two

companies joined hands, adopting the name which they now carry; they hold a Dominion charter, and it is the only street railway company in Canada having this. The present paid up stock of the company is $814,000, with no bonds or other indebtedness standing. The officers are T. Ahearn, president; P. Whelen, vice-president; J. D. Fraser, secretary-treasurer, and J. E. Hutchinson, superintendent. The directors are T. Ahearn, P. Whelen, W. Y. Soper, A. Lumsden, G. P. Brophy, Hon. G. A. Cox, and J. Workman.

The company is working under an agreement with the city of Ottawa for a term of thirty years from August 13th, 1893, whereby it pays the city an annual stipulation of $450 per mile of street covered by its tracks during the fifteen years of its agreement, and $500 per mile during the balance of its term; it is not required to pay the city a percentage of its receipts and is exempt from all taxes, except on real estate. Further, the company agrees to remove all snow from the streets occupied by its tracks, and the city keeps the streets permanently in repair.

The motive power used is entirely a water power, the plant being located on Victoria Island, at the Chaudière Falls, where a head of nineteen feet is secured. The power house is the most modern and up-to-date in every particular in this part of Canada. The building is absolutely fire-proof, being built almost entirely of concrete and steel. The water wheels are all connected to the generator by one shaft 90 feet long and about 15 inches in diameter. The draft tubes go down ten feet and are eight and

MR. J. D. FRASER,
Secretary-Treasurer Ottawa Electric Railway Company.

one-half inches in diameter. The six horizontal water wheels being connected by one shaft do away with all pinions, bearings, etc. The water wheels were manufactured by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, and supply power for an 1,800 horse power plant. The dynamo is capable of generating 1,700 horse power. It was manufactured especially for Ahearn & Soper by the Westinghouse Company, of Pittsburg, Pa. The width, when open, or rather when the fields are parted, is 155 1-2 inches. The dynamo weighs one hundred and five tons: the armature alone is eight feet in diameter and weighs 27 tons.

The road extends over twenty-five miles of streets, nearly all of it being double tracked. There are forty-five miles of track; 40 lb. T rails were used at first, but in all later work 52 lb. girder and 72 lb. high T rails were put down on the main business streets, and 56 lb. T rails on the out-lying districts. Ties are set 2 feet 6 inches between centres and angle fish plates are used. Bonding is done with No. 00 copper wire, cross bonded every 200 feet and connected at intervals to the water mains; where the tracks pass the power house six No. 0000 copper wires are taken from the rails to the negative leads on the station switch-board. A point worthy of note is that trouble with telephone interference has been fully avoided by putting up a large number of copper aerial return wires in addition to the ordinary returns. These lines are distributed to tap the rails at different points of the city, and vary in size from No. 0000 to No. 2. No. 00 hard drawn trolley wire is generally used, though No. 000

MR. G. W. LANG,
Inspector Ottawa Electric Railway Company.

figure 8 is being put up on new work. The lines are well supplied with feeders and the available potential is practically the same at all points.

The rolling stock consists of fifty-eight closed vestibule cars, forty-one open cars, one locomotive, and seven sweepers. The first cars used were built by Patterson & Corbin, of St. Catharines, Ont.; all later ones are of the Ottawa Car Company's make. Westinghouse double equipments are used throughout. Each car is thus fitted with two 30 h.p. motors. The Providence car fender is the one in use.

The company claims the honor of successfully getting rid of the snow, and Ottawa has a superabundance of that commodity. When snow begins to fall, the sweepers are put out immediately; these are followed by the "Walk-away" snow ploughs which shove the snow to the side of the roadway. It is then carted away by horses. Since the road has been in operation, not a single trip has been lost on this account. The car sheds, of which there are five, are located on Albert street and New Edinburgh, each building being 66x100 feet, built of brick with iron trussed roofs. The repair shops and a very commodious

MR. R. INGRAM,
Inspector Ottawa Electric Railway Company.

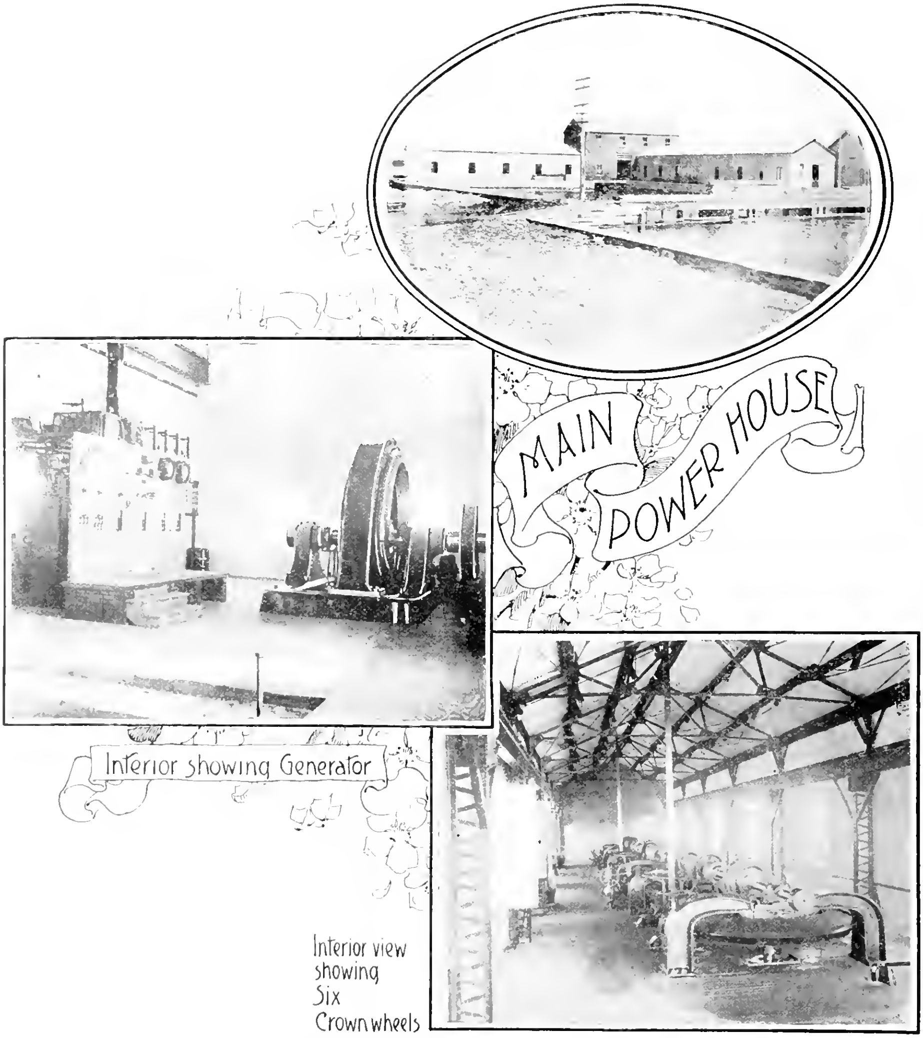
suite of offices are situated in one of these buildings, that on Albert street.

The company transports all mail matter between the post office and railway depots, and carries the letter carriers under agreement with the Dominion Government.

The service was begun in October, 1893, and was the first of its kind on this continent, as is now well known.

Rockliffe Park is a most dèlightful place for recreation, situated as it is among primeval pines on the high bank of the Ottawa river, on the Ontario side, about three miles below the main part of the city. From Rideau Hall outward the railway company has a private roadway winding through beautiful woods along the bank of the river. The company has been running this park as a pleasure ground, and finds it a fruitful source of revenue. The private roadway and the park are brilliantly li_t by arc and incandescent lights supplied with current from the railway circuit.

Britannia-on-the-Bay, about five miles from Ottawa, on the other shore of Lake Deschene, is an ideal summer resort. The view along the Britannia line, running l es the highway and river bank, is pleasing and picturesque. At night the line is brill antly lighted by incandescent lights. One of the chief attractions is the stone promenade pier running one thousand feet out into the lake, at the end of which is a breakwater one hundred feet long and twenty fèet wide. Here band concerts are held throughout the season. The beach is a beautiful sandy one, suitable for bathing. Last summer the company extended its double tracks from Rockliffe park to the new Government Rifle Range, a distance of two miles. This is a beautiful run, the line being built on the brow of the cliff. The scenery is magnificent. The Dominion Rifle Association meeting is held here every summer. Each week the local riflemen also practice at the targets.




VIEWS OF THE CAPITAL POWER COMPANY.

J. E. Hutchison, superintendent of the Ottawa Electric Railway, was first connected with the Canadian Pacific Railway, in various capacities, attaining the position of train-master. He is a popular official and is cred with much of the success the Ottawa Electric Railway has attained. Capt. Hutchison is an officer with 3rd Regiment Ottawa and Carleton Rifles and is one of Canada's crack shots. Mr. J. D. Fraser, secretary-treasurer, assumed the position in 1882 of secretary of the Ottawa City Passenger Railway Company. He accepted a similar position with the Ottawa Electric Railway Company in 1891, continuing after the amalgamation of the two companies in 1893 in his present responsible position. A search of the continent could hardly have located a bètter man for the position, at least this is the opinion of Mr. Fraser's many friends and thousands of fellow citizens Mr. R. Ingram and Mr. G. W. Lang, inspectors, ho'd po sitions in which the exercise of tact and judgment is an hourly requisite. Both gentlemen possess these keynotes to'successful business management, and it is larg

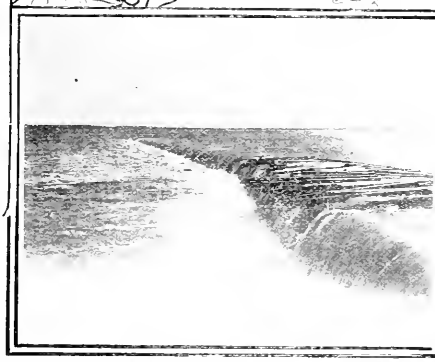
due to their untiring efforts that the Ottawa Electric Railway has attained its present favorable position.

THE CAPITAL POWER COMPANY.

The Capital Power Company, Limited, is one of the latest and most energetic factors in the development of electrical energy in the vicinity of Ottawa. This enterprising concern secured the rights to and possession of the water lots owned by R. & W. Conroy at Deschenes. The latter firm operated a large saw mill by means of the water power, but this industry was wiped out by fire two years ago. Power is secured from the Deschene Rapids, situated on the Ottawa river, about five miles above the Chaudiere Falls. The plant is installed on the north or Quebec side of the river directly opposite the Metropolitan Power Company's scene of operations.

There is 9 feet head of water. In all 11 turbines have been installed, each of which at low water gives 228 h.p. or a total of 2508 h.p. The six wheels at present in operation are controlled by two Woodward governors. The turbines are of the vertical type, measuring 61 inches. The power is transmitted to the jack-shafts by Leffel wheels, the generator being placed on its shaft. There are two 880 k.w. generators, producing 2133 h. p. A second generator will be installed shortly. The direct connection of the generator with the shaft does away with belting. This power is transmitted a distance of five miles, by wire to Hull, where 1,500 h.p. is utilized by the E. B. Eddy Company, and 200 h.p. by the Matthews Packing Company. The alternating current is used at a voltage of 10,000 volts, which is transformed to 440 volts at the Eddy Company's mills and 550 volts at the Matthews Company's factory. The transmission line to Hull is in two sections, of three wires each. The power will be used mainly for manufacturing purposes in Hull. It is leased at from $15 to $25 per h.p. according to quantity.

GRIST MILL AND ELEVATOR



VIEW LOOKING UP LAKE DESCHENES

MAIN STREET, DESCHENES VILLAGE.

Building operations were commenced in the spring of 1900. The flumes are good examples of low head development in concrete. The superstructure is entirely fireproof, it being probably one of the first electrical power houses in which the fire risk has been reduced to a minimum. As such it is worthy of the inspection of the visitors.

The generating house is built of brick, with concrete floor and iron roof lined with asbestos mill board. The two hydraulic power houses are constructed of iron, with expanded metal cement walls. The roof is built of corrugated iron. The plans have been so arranged that the capacity of the power house may be doubled.

Mr. R. J. Devlin, merchant of Ottawa, is president of

the Capital Power Company and chairman of the Board of Directors. Mr. Louis Simpson is managing director. Mr. J. M. Shanley is the Engineer in Chief.

Mr. Louis Simpson, managing director, was formerly general manager of the Montreal Cotton Company. He is a gentleman of experience and energy, and is thoroughly familiar with the electrical field. He states that he is preparing to develop the immense water power at the Chats Rapids on the Ottawa river, 28 miles above the city, and that work will be shortly commenced by an English company, which will develop the power for manufacturing purposes. The Chats Rapids are reached by boat from Aylmer. Deschenes, the scene of the Capital Power Company's operations, is situated between Hull and Aylmer, on the line of the electric road. A visit to the plant will in all probability be arranged for during the convention.

## AHEARN & SOPER.

The history of the above firm gives the key-note to the history of electrical development in Ottawa. The members of the firm are Mr. Thomas Ahearn and Mr. Warren Y. Soper, both prominently identified with the progress of the Capital, as successful promoters of its leading electrical enterprises. The firm is well known throughout the Dominion, it having for many years past been

Mr. Lewis Simpson,
Manager Capital Power Company

Canadian representatives of the Westinghouse Electric & Manufacturing Company of Pittsburg. Ahearn & Soper have installed many extensive plants in various towns and cities. The members of the firm are pioneers in electrical development in Ottawa. They established the Chandiere Light & Power Company in 1886, and were the first to introduce incandescent lighting in Ottawa. In 1890 they organized the Ottawa Electric Railway Company, the road being opened for traffic in June, 1891. They were the first to demonstrate the practicability of operating an electric system during the frigid and fleecy reign of Our Lady of the Snows. The members of the firm are also identified with the Ottawa Electric Company and Ottawa Car Company.

In addition to the commodious office and show room on Sparks street, near Elgin, the firm has a factory on Albert street, adjoining the Ottawa Electric Company's car sheds, where it manufactures switch boards and other electrical devices.

## THE OTTAWA POWER COMPANY.

Situated on Victoria Island, Chandiere, in the city of Ottawa, is the power house of the Ottawa Power Company, Limited, which is a massive stone building 40x85 feet with two penstocks covering a space about 58x70 feet. The walls of the building and penstocks are from 2 to 6 feet feet in thickness, depending upon the strength required in the different locations. The floor and ceiling are made of expanded metal and concrete, the roof of corrugated galvanized iron covering steel rafters. The structure is therefore entirely fire-proof. Each penstock contains two pairs latest improved special 50-inch Samson double horizontal turbines, center discharge, manufactured by Jas. Leffel & Co.,

Mr. T. Ahearn.

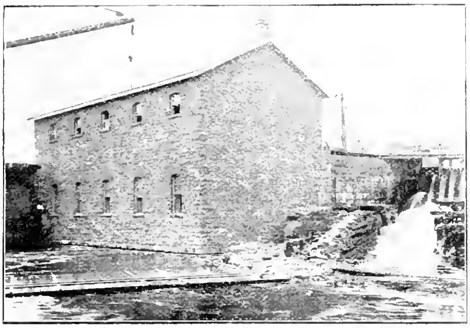
of Springfield, Ohio, planned to develop 2,000 h.p. under a 25 foot head of water. As the two units are identical the capacity of the power house is, therefore, 4,000 h.p. Each set of water wheels has direct connection upon the same horizontal shaft with two electrical machines—one 60 cycle, 44 pole, 1,500 k.w., 163 and a half r. p. m., 2,-300 volt single phase revolting field alternator, and one 38 pole, 200 k.w., 160 r. p. m., 225 volt direct current generator. Both units of electrical machinery of the above description were furnished by the Canadian General Electric Company of Peterborough, Ontario, and are used to furnish electric current and power to the factory of the Ottawa Carbide Company, Limited, a few hundred feet distant. The alternating current is used for the smelting of coke and lime in the manufacture of calcium carbide and the direct current is utilized in the running of motors which operate the crushers, elevators, conveyors, etc., of the carbide factory.

Mr. Warren Y. Soper.

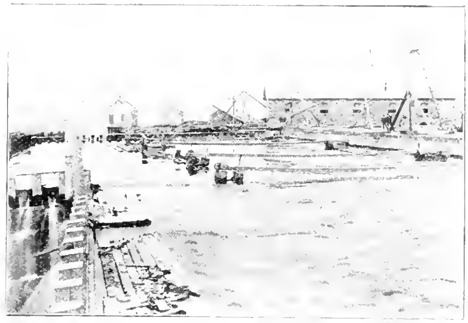
The officers of the Ottawa Power Company are Hon. E. H. Bronson, president; W. G. Bronson, vice-president; and Levi Crannell, secretary-treasurer. The officers of the Ottawa Carbide Company are Hon. E. H. Bronson, president; T. L. Willson, vice-president; Levi Crannell, secretary-treasurer; and F. P. Bronson, managing director.

## HULL ELECTRIC RAILWAY.

The Hull Electric Railway, running from Hull along the Ottawa river to Aylmer, is possessed of unique features bound to attract the attention of electrical engineers. The road was formerly part of the C.P.R. system, connecting with the Pontiac and Pacific line at Aylmer and the C.P.R. main line at Hull. There was then ten miles of single track. In 1896 this was secured by capitalists interested in water powers and lumber mills at Deschenes, midway on the line. The equipment of the road for electric traction was planned and planned successfully. A second parallel track and sidings were laid down, mak 26 miles of track in all. The double tracked line wa ted up as a summer resort. A summer hotel, the "Victoria," was also built midway between Aylmer and th extended through Aylmer to Queen's Park, which was fit park.



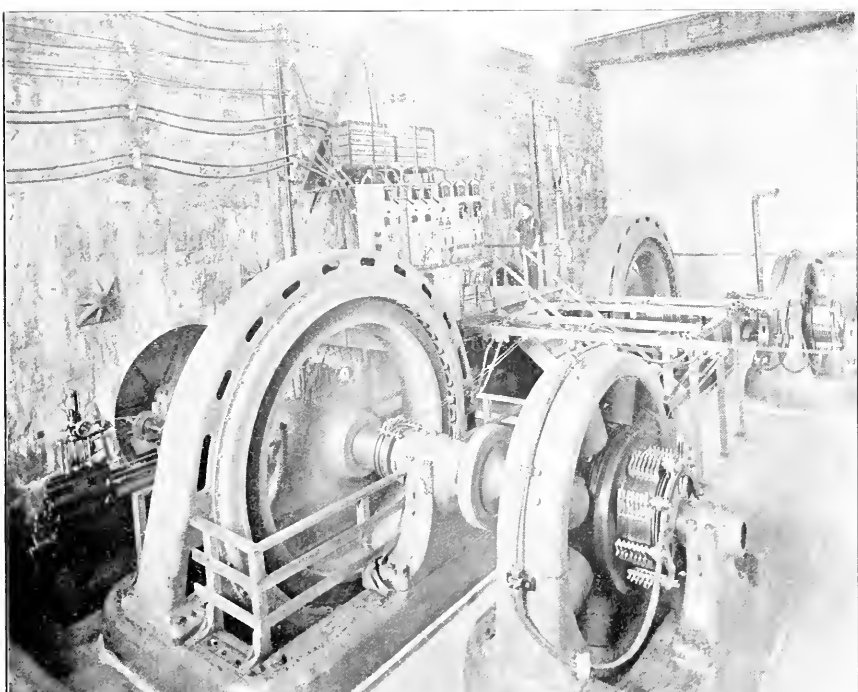
Ottawa Power Company—Power House.



Ottawa Power Company—Pond and Power House.

The car sheds and power house were built at Deschenes where an excellent water power was available at low cost of production. The power house is built of w[illegible] 130 feet long and 40 feet wide. In it there are six [illegible] inch and two [illegible] inch American vertical turbines, capable of developing at the normal head of [illegible] feet, [illegible] h.p., the jack shaft speed being [illegible] r.p.m.

The railway generators consist of [illegible] steel frame machines of the Canadian General Electric Company's standard type, having a capacity of [illegible] k.w. each. Power is also furnished from the jack shaft to operate two 150 [illegible] monocyclic alternators, from which current is furnished for lighting purposes. In a second power house is situated one 250 k.w. monocyclic alternator. This is controlled by a Woodward mechanical governor, which is giving good satisfaction. The first two mentioned are controlled by a Replogle governor. The current is transmitted over bare copper wire, at a voltage of 2,180 with no load, and 2,300 volts at full load. Current is used for the lighting system of the Hull Company in Hull and the Deschene Electric Light Company in Ottawa. The use of water wheel governors alone not having been found sufficient to give a reasonably constant speed under the violent load fluctuations experienced when operating the electric locomotives and cars, this difficulty was overcome by a



Ottawa Power Company—Interior of Power House.

imple and positive method. With the idea of keeping the load equal on the machines, despite the different variations on the road, an automatic load is thrown on at the power house. This is managed by means of an automatic electric switch. For example, when a car is going down grade or brought to a standstill, the outside load or pres-

MR. W. G. BRONSON,
Vice President Ottawa Power Company.

sure is thus removed from the machines. It is then that the local automatic action is applied.

Anchor ice has been a great source of trouble at power houses in the vicinity of Ottawa. This difficulty was overcome at the Hull Electric Company's plant, by the erection of a dam. The water moving at a reduced velocity, it is found, does not carry with it as much ice as it does at a higher speed. A wing dam 300 feet in length has been built, and the head of water thereby raised six inches. This company owns the water lots extending to the middle of the river, and it is estimated that between 3,000 and 4,000 additional h.p. can be developed. On the opposite shore, the Ontario side, are the extensive works of the Metropolitan Company, now under construction.

The Hull Company's power house narrowly escaped destruction by fire when the Conroy saw mills on the present site of the Capital Company's works, were burned two years ago. The premises are now fully protected. A rotary pump is installed with 400 revolutions and a ca-

MR. LEVI CRANNELL,
Secretary-Treasurer Ottawa Power Company and Ottawa C rbide Company.

pacity of 800 gallons a minute. The present electrical plant was installed at a cost of $35,000. It is modern and complete. Mr. James Robertson has been in charge since the plant was installed. He is an efficient electrician, wide awake, well read and in step in the matter of improvements.

The car houses located next the main line at Deschenes are built of stone.

The rolling stock consists of 19 double truck motor cars, of which 13 are open and six closed. There are also two single truck 21 foot cars for use in Hull city, a spur line running for a distance of two miles along the Main street and northeast to Gilmour's mills. The equipment both for the open and closed cars consists of four G.E. 1,000 motors. The closed cars are geared to run at 35 miles an hour, and the open cars at 25 to 30 miles. The original equipment for the double truck cars was two 50 h.p. motors, but these were not equal to the occasion.

The Hull Electric Company also operates two electric locomotives, and a combination mail and baggage car. The latter is equipped with 2 G.E. 1,200 motors. The first locomotive purchased at the opening of the electric road, consists of a 22 foot 8-inch body mounted on heavy Blackwell trucks. It is equipped with four G.E. 1,200 motors, geared to run at 20 miles an hour. The second locomotive is a much more powerful machine. The body is 26 feet in length and the equipment consists of four G.E. 41 motors, capable of developing 80 h.p. each, mounted on McGuire "L" trucks with steel rimmed wheels. This locomotive is eqqipped with standard air brakes and oper-

MR. F. P. BRONSON,
Managing Director Ottawa Carbide Company.

ated by a motor driven compressor placed in the cab. As many as 33 freight cars have been handled, but the ordinary load is twelve loaded freight cars. For the smaller locomotive it is six loaded freight cars. The cost of repairs is low as compared with a steam locomotive. There is also a greatly reduced cost for cleaners and others.

The Hull Company has also a Ruggles rotary snow plow and a snow plow manufactured by the Canadian General Electric Company, known as the double nosed plow. By it the snow is taken from one side of the track, and lifted to the other, not divided in the centre as with the ordinary plow. The cars are also provided wieh attached plows. These have been operated with great success, as the road has been kept clear in storms that blocked the steam lines.

The officers of the Hull Electric Company are: Pres., W. P. Conroy; vice-pres., Alexander Fraser; sec.-treas., W. R. Taylor; trainmaster, A. E. Latimer. Mr. Taylor, who is an efficient, energetic official, popular with all patrons of the road, entered on his railraad career with the G.T.Ry. in accept a position with the Missouri Pacific. He remained with that company 10 years, and assumed his present position with the Hull Electric Company when the line was started. Mr. Albert E. Latimer, trainmaster, was formerly with the C. P. Ry before assuming his present position. All convention visitors should avail themselves of an opportunity to enjoy the run along the bank of the beautiful Ottawa on the Hull electric line.

### OTTAWA CAR COMPANY.

A concern that has brought no small measure of fame and fortune to Ottawa and Ottawans is the Ottawa Car Company. Its extensive works are situated on Slater street, south of the Ottawa Electric Railway Company's car sheds on Albert street. The company build trolley cars, high grade waggons, carriages and other vehicles. Its army waggons won favorable comment during the South African war when they were used as transports by both Colonial troops and units from the British Isles. The concern was established in 1891, when it employed 30 hands. Now it employs over 100 men, and its cars cover the street railways of Canada from St. John's, N.B., to Vancouver, B.C. The weekly pay list is over $1,000, and 100 cars a year are turned out.

Mr. A. E. Latimer,
Trainmaster, Hull Railway.

Electricity is used in the works as an auxiliary power to operate the heating and lighting systems after the steam plant is shut down for the day.

### BELL TELEPHONE COMPANY.

In the last convention number of the Canadian Electrical News, this system was illustrated and described at considerable length. It was modern in every particular and its equipment is extensive and elaborate. The home of the company is on Queen street, near Elgin, in the business centre. The block is one of the most imposing in the Capital, being a three-storey solid brick, with sandstone trimmings. All lines entering the building come in in cables through the basement from the street underground system. These cables vary in size, from those containing 50 pairs of wires to larger ones of 200 capacity. At present there are about 3,000 miles of telephone wires underground in the city of Ottawa. The local manager is Mr. J. E. McPherson.

### OTTAWA BRANCH G. N. W. TELEGRAPH COMPANY.

Away back in 1847, when dots and dashes played but little part in the business world, a class of young men met in Montreal to study telegraphy. All but one of that class have left the telegraph key forever, the only survivor, Mr. N. W. Bethune, the superintendent of the Great North Western Telegraph Company, is still in the business. Every day he is at his office in the splendid building used by the G N W Company as headquarters in Ottawa. Mr. Bethune is one of the oldest Canadian telegraphers. When he entered the class in 1847, it was to learn the dot and dash system so that he might be ready to take a position with the Montreal Telegraph Company, which was then building its lines. The class was under the tuition of Mr O. S. Woods, the first superintendent of the Montreal Company, and who may be considered the father of the telegraph in Canada. Mr Bethune has served in many offices in Canada. He spent some years of his early life in the United States, and in 1885 he returned to the service of the Montreal Telegraph Company as local manager of the Montreal office. He retained that position until 1893, when he was sent to Ottawa to prepare that office for the anticipated removal of the seat of government to Ottawa. He took an active share in the erection of lines throughout the Ottawa valley, and he has remained in charge of the district to the present day

Mr. W. R. Taylor,
Secretary-Treasurer, Hull Electric Railway.

The Ottawa office of the G N W Company is located in a fine three-storey structure of Nepean stone, faced with cut Ohio sandstone, at the northwest corner of Metcalfe and Sparks streets, in the best business section of the city.

The operating room, which is about fifty-three feet long, is situated on the third floor. It contains five quarter tables, each holding four sets of instruments, with one polar duplex and two setts of repeaters. There is also a range of side tables with glass partitions dividing the different setts of instruments, some of which are especially arranged for typewriters. A prominent feature of this room is the main switch-board capable of accommodating fifty lines and furnished with electric lamp detectors which give immediate warning of crossed or grounded lines, due to lighting or other causes. In rear of the switch board is a small room containing the storage local batteries, with the dynamo for charging them and the necessary switches. Immediately above this room is the battery room containing the storage batteries for working all the lines running out of the office. Of these there are six to Montreal, six to Toronto, and also a dozen way lines running in different directions.

Mr. N. W. Bethune,
Superintendent Ottawa Branch G. N. W. Telegraph Company.

When Mr Bethune came to Ottawa there were only sixty miles of telegraph wire leading from Ottawa. In 1901 there are nearly 3,000 miles of the G N W wire alone. In 1893 there was only one sub office in the district, now there are 150. The staff in the Ottawa office numbers 50 made up of operators, clerks, messengers and linemen.

Mr. Bethune's district extends to the Island of Montreal on the east and to Kingston on the west, to Desert in the upper Gatineau and up the Ottawa river to Mattawa.

There are many "old telegraphers" in Ottawa, throughout Canada and the United States who have learned the business under Mr. Bethune, and they have none but the pleasantest recollections of the veteran chief. Time has dealt kindly with Mr. Bethune, and although he has reached a time in his life when most men retire from active business, he sticks to work and would pass easily for a man in the fifties. The photo of Mr. Bethune, which appears in this issue, although taken some years ago, represents the veteran as he is to-day, probably the oldest Canadian telegrapher in the business. Mr. Bethune was a superintendent when he was twenty-one years o

### C. P. R. TELEGRAPH COMPANY.

Ottawa has the honor of being the first place in Canada where a storage battery has been installed for telegraph purposes. This plant was put in operation by the C P R Telegraph Company, in 1896, and gave such general satisfaction that storage batteries have since been installed in St. John, N B., Winnipeg, Vancouver, B C., and elsewhere.

The line was opened for business in the fall of 1896, and the service has been so satisfactory to the general

public that the business has increased largely each year, making additional wires necessary. Many of these wires are worked duplex and quadruple. There are 28 wires radiating from Ottawa. Three of these are worked to Montreal and Toronto on the quad system, by which four operators can work on one wire simultaneously. There are branch offices in Ottawa at several points besides the main office on the corner of Elgin and Sparks streets.

### THE EDDY ESTABLISHMENT.

Eddy's matches and woodenware have made Hull famous in thousands of households. The establishments are situated on the Quebec side of the Ottawa river, at the terminus of the Ottawa Electric Railway beyond the Chaudiere.

The electrical equipments of the Eddy establishment is board, supplied the Electrical Construction Company., of a unique and interesting one. Electrical energy is used for lighting, manufacturing and welding purposes, three distinct plants being in operation. Part of the fire-fighting apparatus is also operated by the same means.

The American generators, motors and other electrical machinery imported, were supplied and installed by Ahearn & Soper of Ottawa. A detailed description of the electrical equipment of this establishment was arranged for but lack of space prevents its publication.

### J. R. BOOTH'S INDUSTRIES.

No visitor to the convention should miss a view of Mr J. R. Booth's large lumber mill and extensive yards. The former and part of the latter are situated on Bridge street, at the Chaudiere. Electricity plays an important part in this industry. In the power house at the rear of the saw mill, are two 150 k.w. generators, 4,400 volts, utilized for the transmission of power to the Canada Atlantic Railway car shops four miles distant. This is known as the three-phase system. All the parts were installed by the Canadian General Electric Company, of


His Worship, Mayor Morris, of Ottawa.

Peterborough. Situated at these shops are three 100 k.w. synchronous motors, one at the car shops and two at the machine shops. By this system the lighting of the shops is also accomplished, there being installed 1,000 incandescent and several long burning arc lights.

The saw mill and adjacent buildings at the Chaudiere are lighted from five T. H. arc machines. There are 140 arc lamps and 600 incandescent lights. The work-shop nearby is also run from a 25 h.p. motor, operated from the mill plant. In the power house are three kinds of wheels, the New American, Leffel and Sampson.

A factor in the Booth electrical system worthy of more than a passing note is one of the Thomson & Houston arc machines, which operates 35 lights. It was installed

Mr. G. F. Macdonald, City Electrician.

over 20 years ago by Mr. Fred Thomson, of Montreal, and is to-day doing effective and useful work.

### FIRE PROTECTION EQUIPMENT.

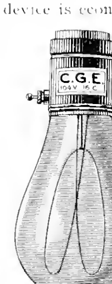
Ottawa's electric fire alarm system is in charge of Mr George F. Macdonald, who has his office and work-shop in the city hall. The city is served by 100 boxes connected withthe central office and fire stations, by covered wire, of which there is 60 miles.

Superintendent Macdonald has kept step in the march of progress, and to-day, although the amount of outside wire has been increased 1,000 per cent., the system is operated with 75 per cent. less trouble than it was at the beginning.

Ottawa's fire department is the pride of the Capital. The head of the department is Chief Provost, a fire fighter of 18 years experience, who, previous to assuming control in Ottawa, was connected with the Montreal brigade. He has two deputy chiefs and 51 men. There are in the city nine well arranged attractive looking stations. The fire fighting appliances include a Lafranc steamer and a Waterous steamer recently purchased. There are also two aerial trucks, one in active service, besides nine hose waggons and two Seagrave hook and ladder trucks, the first adopted in Canada. Electricity plays an important part in the operations of the brigade.

## NIGHT LAMPS.

For some time the Canadian General Electric Company have had on the market a night lamp which removes the objection to the incandescent lamp that it cannot be turned down or dimmed. By a simple movement of the milled screw, provided on this lamp, and shown in the accompanying illustration, the candle power is changed from 16 to 1. The device is economical as well as simple



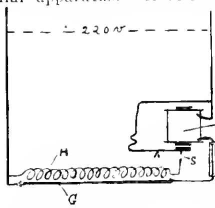

C. G. E. Night Lamp.

since the current consumed is reduced with the candle power to a negligible amount. This feature will appeal to consumers who find it necessary to keep lights burning all night. The Canadian General Electric Company advise us that the lamp has been found to be highly satisfactory. Other advantages claimed for it are that it fits any standard socket like an ordinary lamp, may be moved from one socket to another, and used with any kind of a shade or reflector, and that one socket is available for giving lights of two different intensities.

## THE NERNST LAMP AT THE PAN-AMERICAN EXPOSITION.

(By a Correspondent.)

Probably the most interesting of the many features of the Pan-American Exposition on Dedication Day, Monday, May 20th, was the illumination of the central portion of the Electricity Building by means of Nernst lamps—the first public exhibition of Nernst lamps in America. When these lamps were turned on it was as if daylight were shining from the interior of the dome of the Electricity Building, and the arc lamps which up to this time appeared to light the building thoroughly were outshone completely by the brilliancy and numbers of the Nernst lamps. The Nernst lamp is famous for its efficiency, and those in charge of the display at Buffalo stated that the lamps they were exhibiting were rated at 1.5 watts per candle, or more than twice as efficient as the ordinary incandescent lamp. As is well known, the glower in the Nernst lamp is made of rare earths which are non-conductors until heated, and consequently the glower will not carry current until its temperature is raised by the application of a torch or similar apparatus. A reference to the diagram




will give an idea of how this arrangement is carried out at Buffalo, and it also shows a device for controlling the amount of current passing through the glower and the consequent brilliancy of the lamp.

G—glower which becomes a conductor when its temperature is raised sufficiently.

H—heater of German silver supported by an asbestos plaster case.

R—regulator made of iron wire enclosed in glass tube.

C—coil for operating armature which controls switch in heater circuit.

S—switch.

The lamps are operated on a 220 volt circuit; when they are turned on current flows through the heater circuit and its switch, which is closed by gravity. As soon as the temperature of the glower begins to rise, its conductivity increases and current flows through it and its regulator R, as well as through the coil C, which latter is so arranged that when the current reaches a predetermined amount it lifts the armature which opens the switch S, thus cutting off the heater circuit and allowing the current to flow through the glower circuit only. The amount of current in the glower circuit remains constant under wide variations of pressure; the iron wire regulator's resistance increases so rapidly with an increase of current that it actually prevents the current from varying except within the narrowest margins.

The lamps are made in various sizes, those of high candle power being made up of a number of glowers in parallel, each glower being supplied with automatic heating and regulating devices. The glowers appeared to be about an inch and three-quarters long and one-eighth of an inch in diameter. The Westinghouse Company occupy the central portion of the Electricity Building, and they will use Nernst lamps exclusively during the Exposition, supplied with current from their own plant. On Dedication Day the Exposition authorities courteously supplied them with current, as their own apparatus was not ready. Mr. A. J. Wurtz, of Lightning Arrester fame, has developed the lamp described, and he has been assisted by Mr. Bert Fleming, formerly of Ottawa, who graciously described the workings of the lamp to a party of Canadians who visited the Exposition after the recent convention of the National Electric Light Association.

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The La Patrie Publishing Company, Montreal, Que., have recently installed a 200 light dynamo, also switchboard, supplied by the Electrical Construction Company of London, Limited. The La Patrie Company had shortly before this installed another dynamo, made by the same company.

The Electrical Construction Company, of London, Limited, have recently completed the following contracts: Three dynamos for John Starr, Son & Co., Halifax, N. S.; five dynamos for Bennett & Wright, Toronto; three dynamos for Darling Bros., Montreal; 100 light dynamo for H. Shaw, St. Catharines; one 5 h.p. dynamo for Geo. A. McGowan, Kingston; one motor for the Thorold Pulp Company; two motors for L. Allcocks, Sault Ste. Marie; three motors for Stuart, Arbuthnot Machinery Company, Winnipeg; two motors for the Electric Repair & Contracting Company, Montreal.

## THE SAYER ELECTRIC COMPANY.

Prominent among electrical contractors and dealers in apparatus and supplies is the Sayer Electric Company, situated at 60 and 62 Victoria Square, Montreal, Que. This firm was established in 1899, E. W. Sayer being appointed manager. Mr. Sayer is a young man, 25 years of age, who has had a wide experience in electrical matters, having been associated for four years with T. W. Ness, and subsequently for two years with the Montreal

MR. E. W. SAYER,
Manager Sayer Electric Company.

Electric Company. The firm carries in stock all the most modern appliances known to the trade, and make a specialty of installing private power plants for arc and incandescent lighting, warehouse telephones, also doctor's and dentists' electrical specialties, which, wherever installed and used, have given satisfaction. The firm has recently installed plants in a large number of the prominent business establishments of Montreal, among them being Jas. Shearer Company, lumber merchants; Canadian Rubber Company, Canada Paint Company, Reinhardt & Company, brewers, and the Laing Manufacturing Company, St. Henri.

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## THOMAS A. FARRELL.

Prominent among the young and favorably known men in the electrical business is Mr. Thomas A. Farrell, who is located at 62 Victoria Square, Montreal. Mr. Farrell was associated with the well known firm of R. E. T. Pringle, where his genial personality and up-to-date business methods gained for him general esteem. Some time ago he decided to take up business on his own account, and the success which he has since met with has fully justified the wisdom of this step. In the short time he has been in business he has built up a large connection, having filled orders from almost every part of the country. He has several agencies, the largest being the sole agency for the Electrical Construction Company, of London, Ont., with whom he is doing a large and increasing business, his territory embracing the Province of Quebec and Ontario, as far west as Kingston and north through the Ottawa valley. He is also the Canadian representative for the Warren Company, Chicago, U.S.

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Mr. Thos. A. Farrell has recently installed a marble switch-board in John P. Black & Company's new plant, Montreal, Que.

As a result of the recent call for tenders for the new electric light plant for the town of Blenheim, Ont., the Electrical Construction Company, of London, Limited, have secured the complete contract for wiring, both street and house, supply of switch-board, transformers, and all other supplies needed.

Messrs. Babcock & Wilcox, Limited, whose advertisement appears in this number, will be pleased to send free to any of our subscribers a copy of their valuable treatise entitled "Steam." The company are prepared to give estimates for complete boiler house plants.

The Montmagny Light & Pulp Company, Montmagny, P.Q., who are now running their works by water power, are installing a steam plant for use during the dry summer seasons. It will consist of a 200 horse power Robb-Armstrong engine and two 100 horse power Mumford boilers, to be supplied by the Robb-Armstrong Engineering Company.

Mr. William S. Aldrich, who has been connected with the teaching staff of the Engineering Department of Illinois University, at Urbana, Ill., has decided to open an office in Toronto as consulting electrical engineer. Mr. Aldrich has associated himself with Mr. Cecil B. Smith, C.E., who has for several years been connected with the City Engineer's Department in Toronto and who will make a specialty of municipal engineering work.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.

BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2290.

**The C. E. A.** In this number will be found the programme of the annual convention of the Association, which will open in Ottawa on the 19th inst. It will be seen that excellent provision has been made for the instruction and enjoyment of those who may participate. In the pages of this issue will also be found descriptions and numerous illustrations of the electrical and many other features of interest which the Capital has to offer for the pleasure and instruction of the stranger within her gates. The citizens of Ottawa are noted for their open-handed hospitality no less than for their business enterprise, and everybody who attends the coming convention will receive a cordial welcome. If the attendance should prove worthy of the occasion, as we earnestly hope it may, the meeting at Ottawa this year should be the most successful in the history of the Association.

**The Nernst Lamp** We are indebted to a correspondent who recently visited Buffalo for the particulars and diagram printed in this number of the Nernst lamps that are being used to illuminate the Electric Tower at the Pan-American Exhibition. He speaks highly of the illuminating power of these lamps. Regarding their adaptability for commercial lighting, under ordinary conditions, our correspondent says: "There is undoubtedly a great future in store for the Nernst lamp, particularly as applied to the illumination of large interiors, such as departmental stores, public halls, etc. Its efficiency will make it a boon to both the central station and the consumer, and its beautiful color—nearly approaching daylight—places it in the foremost rank of illuminants. The question on every electric light man's lips at Buffalo was, 'When will you be in a position to supply us?'"

**Meter Inspection** At the recent session of the Dominion Parliament, an amendment was made to the Electric Light Inspection Act. It provides that no meter, after it has been fixed for use, shall be verified or tested by any person excepting the Government inspector. In the event of an inspected meter being found on re-inspection to vary from the standard, the user is only to be entitled to the gain which has taken place during the three months immediately prior to such re-inspection. It also provides that no meter shall be stamped which is found by the inspector to register quantities varying from the legal standard unit of electricity more than three per cent. in favor of either the seller or consumer. If the meter is found correct, the fee, fifty cents, is to be paid by the consumer; if incorrect, by the electric light company. A clause of the amendment further provides that every person except the inspector who verifies or tests any meter after it has been fixed for use is rendered liable to a penalty of $25 for every meter verified or so tested. The Governor-General-in-Council is given power to establish regulations for the testing of electric light lamps, or to determine what style of meter shall be used to measure the quantity of electric energy supplied. The Gas Inspection Act was amended in like manner.

## PERSONAL.

Mr. E. F. Valiquet of Marlbank, Ont., has recently been appointed eastern representative for the Dodge Manufacturing Company, Toronto, with headquarters in Montreal.

Mr. R. F. Morkill, formerly of Sherbrooke, has been appointed superintendent of the St. John's Street Railway System at St. John's, Newfoundland, which system is owned by Mr. R. G. Reid. Mr. Morkill has recently installed C. G. E. Series Alternating Enclosed Arc System, 75 light special transformer, and is now engaged in changing the old ones.

Mr. W. Wallace, A.M.I.C.E., M.I.N.A., representing Messrs. John Brown & Co., Limited, Atlas Steel Works Sheffield, is at present on a visit to the United States and Canada for the purpose of introducing in these markets certain lines of goods for which there is believed to be a demand. Mr. Wallace was formerly a resident of Hamilton, having been associated with the Mr. J. H. Lilley, and also with the development of the water works system of that city, and is consequently familiar with the conditions in this country.

Mr. J. G. Bain, traveller for the Atlantic Refining Company, Toronto, accompanied by Mrs. Bain, will sail from Montreal about the middle of June for the British Isles, where they will spend a couple of months. Mr. Bain's health has of late been somewhat impaired, hence his decision to take a well-earned vacation. Mrs. Bain is an accomplished vocalist and her Scotch songs will doubtless be appreciated in "The Land of the Heather." We wish them bon voyage.

## NATIONAL ELECTRIC LIGHT ASSOCIATION.

About 350 persons were in attendance at the twenty-fourth convention of the National Electric Light Association, which opened in Niagara Falls, N.Y., on May 21st. The business proceedings were of an interesting character, but there were very few exhibits of electrical apparatus, due to the close proximity of the Pan-American Exposition.

Following the address of President Cahoon, a paper was read by C. W. Rice of New York, on "The Transmission of Current at High Potential in New York City," in the discussion of which a prominent part was taken by Frederic Nichols of Toronto. An interesting paper on "The Practical Side of the Incandescent Lamp" was read by Mr. F. W. Wilcox, of the General Electric Company. It contained many suggestions of value to central station managers. A feature of the paper was that Mr. Wilcox advocated free lamp renewals as the key to the incandescent-lighting system, and asserted that the lamps should be periodically replaced at regular intervals. L. R. Wallace, of Woburn, Mass., submitted a paper on "The Foresee System of Charging," the discussion on which was opened by Edward Slade of Quebec. A number of other valuable technical papers were presented and discussed.

In the absence of Dr. Louis Bell, James I. Ayer read the report of the committee on the standard candle power of incandescent lamps. It was stated that owing to changes in the shape of filaments, it was found advisable to take no further steps this year towards the standardization of lamps. The numerous changes were referred to in the report, which was referred to the executive committee, with power to act.

An interesting report was presented by the committee appointed to investigate the photometric value of arc lamps. The report stated what had been accomplished during the year, and dealt chiefly with the life and efficiency of commercial brands of enclosed arc lamps. Five well-known brands of carbons were tested, three of these being of American and two of European manufacture. It was shown that four of the five brands gave approximately the same luminous intensity after seventy-five hours' burning, and that nearly all the carbons showed a better performance after burning for several hours than at first.

The election of officers resulted in bringing distinction to a Canadian central station manager, Charles B. Hunt, of London, Ont., being chosen as second vice-president of the association. Honor was likewise done to another Canadian, in the preson of Frederic Nichols, vice-president and managing director of the Canadian General Electric Company, upon whom was conferred an honorary membership. Mr. Nichols is a past president of the association, and during his term of office gave the best of attention to the business of the association. It is understood that this is the second instance only in which an honorary membership has been given by the association, and it will doubtless be a source of congratulation that this distinction has fallen to Mr. Nichols, by whom it is well deserved.

The Canadians present at the convention included: Frederic Nichols, manager Canadian General Electric Company, Toronto; R. B. Hamilton and G. A. Powell, Packard Electric Company, St. Catharines; C. B. Hunt, London Electric Company; R. S. Kelsch, Lachine Rapids Hydraulic and Land Company, Montreal; Edward Slade, Jacques Cartier Water Power Company, Quebec; E. D. McCormick and H. G. Nichols, Canadian General Electric Company, Toronto; John Murphy, Ottawa Electric Company, Ottawa; George H. Olney, 2nd, Eugene F. Philips Electric Company, Montreal; E. F. Seixas, Niagara, St. Catharines and Toronto Railway Company.

# ENGINEERING and MECHANICS

## THE EXPANSION OF STEAM.*

One of the most interesting problems connected with the study of the steam engine is that of the laws governing the expansion of steam and their results as affecting the economy and efficiency of the modern steam engine.

Almost the first application of steam as a motive power was in the pumping of water from mines. The engines used for this purpose consisted of a vertical cylinder fitted with an air tight piston, and having its upper end open to the atmosphere. The piston was connected to one end of a walking beam, to the other end of which was attached the rods connecting it to the pump at the bottom of the mine, the weight of the plunger and connections being sufficient, when not in use, to draw the piston to the top of the cylinder. Steam was admitted below the piston at very little above atmospheric pressure, just sufficient to expel the air. When this was done and the cylinder filled with steam, the admission valve was closed and a jet of cold water was sprayed into the cylinder, condensing the steam and forming a vacuum below the piston, when the pressure of the atmosphere on the upper side of the piston forced it down, raising the other end of the beam, and the plunger of the pump with it, thus lifting the water. When the piston had descended as far as it would go, steam was again admitted to the cylinder, destroying the vacuum, when the weight of the plunger and connections raised the piston to the top of the cylinder again, ready to repeat the operation.

As you will see, the pressure of the steam played a very unimportant part in this engine, being only used to counteract the atmospheric pressure. It was found that the loss of time and heat required in the alternate heating and cooling of the cylinder walls made this a slow and expensive method, and this suggested the use of a separate vessel for condensing the steam, which was called a condenser. Gradually, too, the pressure of the steam was increased and taken advantage of to assist the atmospheric pressure; but for a long time the highest pressure used was about 6 or 7 pounds per square inch above the atmosphere.

As the phenomenon of heat and the laws governing the expansion of steam became better understood, the advantages of using still higher pressures and using the steam expansively became apparent, until to-day we have engines using steam of 300 pounds pressure, and expanding it to 15 or 20 times its original volume.

To illustrate the expansion power of steam I cannot do better than to quote from D. K. Clarke's excellent work on the steam engine.

"Let us assume a tall vertical cylinder, open at the upper end into which a piston is inserted with a quantity of water at the bottom and a fire applied below to convert the water into steam. In this case, the boiler and engine are represented by one vessel in which the piston and the water are brought into direct contact, and intervening pipes and passages for the steam are dispensed with. Let the cylinder have a diameter of about 13 1-2 inches, making one square foot of sectional area. In the bottom of this cylinder we will put one pound of water, equal to a little less than one-fifth of an inch in depth, on which the piston rests. Let a fire be lit underneath the cylinder to heat the water and convert it into steam. Since the upper end of the cylinder is open to the atmosphere, atmospheric pressure, equal to 14.7 lbs. per square inch, acts upon the piston, amounting to 2,116.4 pounds on the square foot of surface of the piston. The temperature of the water under atmospheric pressure will be raised to 212 degrees Fah. before any steam is generated, and if the heat of the fire be continued the temperature will remain stationary at 212 degrees, but steam will be formed and disengaged under the piston. To simplify our illustration, we will assume that the piston is without weight and frictionless. As steam is formed, the piston will be raised with its atmospheric load of 2,116.4 pounds through consecutive stages until it reaches an elevation of 26.36 feet from the bottom of the cylinder, when the whole of the pound of water will have been evaporated, having had a constant elasticity of 14.7 pounds per square inch and a temperature of 212 degrees Fah.: that is to say, the pound of water is evaporated into saturated steam of atmospheric pressure and occupies a volume of 26.36 cubic feet for the sectional area of the piston, being one square foot, and the height to which it is raised being 26.36 feet, the capacity or volume of the steam equals 1x26.36 equals 26.36 cubic feet. The work done by the steam on the piston consists in having lifted a weight of 2116.4 pounds through a height of 26.36, which expressed in foot pounds is 2116.4x26.36 equal 55.788 foot pounds."

Such an experiment as the one described affords a vivid conception of the expansiveness and force of water when converted into steam. A stratum of water scarcely one-fifth of an inch in thickness lies at the bottom of a cylinder 13 1-2 inches in diameter. This thin disc of water is converted by the application of heat into a column of atmospheric steam of 1,642 times its volume, and the work that has been done in converting the water into steam is equal to the lifting of 27 tons (2000 pounds each) and 1788 one foot high. As the heat unit is equivalent to 772 foot pounds, the value of this performance expressed in heat units converted into work is —

$$\frac{55.788}{772} = 72.3 \text{ units of heat.}$$

In the foregoing illustration we have assumed that the piston was without weight and frictionless. Let us now assume that it (the piston) has a weight equal to 15 pounds per square inch, or 2,160 pounds. This added to the atmospheric pressure would bring the total load on the piston to 30 pounds per square inch, or two atmospheres, equal to 4,320 pounds. We will again place one pound of water in the bottom of the cylinder on which the piston rests, and lighting a fire under it we will find that the temperature of the water will rise to 250.4 degrees Fah. before any steam is generated. If the heat of the fire be continued, the temperature will remain stationary at that point, but steam will be formed and disengaged under the piston as before. The piston, with its total load of 4,320 pounds, will be raised through successive stages until it reaches an elevation of 13.46 feet above the bottom of the cylinder, when the whole of the pound of water will have been evaporated into steam having a constant elasticity of 30 pounds (gross) per square inch.

The external work done will in this case have been 4,320 pounds raised to a height of 13.46 feet, or 58.147 foot pounds, as against 55.788 foot pounds in the first example. Dividing 58.147 foot pounds by 772, the mechanical equivalent of one heat unit, we have 75.3 heat units converted into work as against 72.3 H. U. in the first illustration. The water will have expanded into 839 times its original volume against 1,642 times under one atmosphere of pressure. To make this more clear I will put it in the form of a table:—

| Experiment | Gross Press. lbs. per sq. in. | Volume. | Relative Volume of Steam. | Gross Work. | H. U. Equivalent. |
|---|---|---|---|---|---|
| 1 | 14.7 | 26.36 | 1642 | 55.788 | 72.3 |
| 2 | 30 | 13.46 | 839 | 58.147 | 75.3 |

From this statement it will be seen that the volumes occupied by the steam generated under increasing pressures are reduced nearly in the inverse ratio of the pressures, but not quite so fast, so that as a result the products of the pressures by the volumes, or the gross work done by the steam, is slightly increased with the increase of pressure, and of course the quantity of heat converted into work, the gross work done against two atmospheres being 4 per cent. more than that against one. The total heat expended in generating one pound of steam is also increased with the pressure, the heat units required (assuming the water to be supplied at 212 degrees Fah.) to convert one pound of water into steam at atmospheric pressure being 965.2, and at two atmospheres (30 pounds) equals 976.0.

Having thus illustrated the expansion force of water when converted into steam, let us briefly consider how it affects the efficiency of the steam engine. For this purpose we will assume a steam cylinder 13 1-2 inches diameter and having a stroke of 4 feet; a 13 1-2 cylinder would have an area of (approximately) 1 square foot, and the cylinder would have a volume of 4 cubic feet.

For the sake of simplifying our illustration, we will neglect clearance, cylinder condensation, etc. We will assume that steam is admitted to this cylinder at a pressure of 100 pounds. The pressure on the piston would then be 144x100 equals 14,400 pounds. Let the steam be admitted for the full length of the stroke, we would have 14,400 pounds moved a distance of 4 feet, or 57,600 foot pounds on an expenditure of 4 cubic feet of steam.

Let us next take a cylinder of 27 inches diameter, or 4 square feet area of piston. This cylinder would also have a stroke of 4 feet, or a cubic capacity of 16 cubic feet. Let steam be admitted to this cylinder also at 100 pounds pressure per square inch. But when the piston has moved a distance of 1 foot from the beginning of its stroke we will close the admission valve, thus preventing any more steam from entering the cylinder. We have now admitted 4 cubic feet of steam, the same as in the first example: and the pressure on the piston being 576 inches x100 or 57,600 pounds, and the piston having moved a distance of 1 foot, the work done is 57,600 foot pounds, or exactly the same as in the smaller cylinder. But we still have 4 cubic feet of steam at its original pressure of 100 pounds per square inch imprisoned behind the piston,

*Paper by Mr. O. P. St. John, read before Toronto No. 1, Canadian Association Stationary Engineers

and as the piston still has three feet of its stroke to complete, it will, if the resistance be not too great, continue to move, impelled by the pressure of the steam behind it. When it has moved another foot, or two feet in all, the volume of steam will have increased to 8 cubic feet; but as the admission valve was closed at the end of the first foot of its stroke, and no more steam has entered the cylinder after that, the pressure will be reduced.

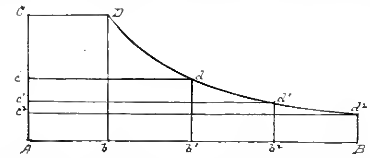
The investigations of Boyle & Marriotte into the laws governing the expansion of the gases show that, practically speaking, the pressure decreases in an inverse ratio as the volume increases; so that while we have twice the volume in this case, we would have at the end of the second foot just one-half the pressure, or 50 pounds per square inch impelling the piston forward. At the end of the third foot of its stroke, the volume would have increased three times, or to 12 cubic feet, while the pressure would have decreased to one third the original pressure, or 33 1-3 pounds; and at the end of the 4th or last foot of its stroke the volume of steam would be four times its original volume, or 16 cubic feet while the pressure would have fallen to 25 pounds per square inch, or 1-4 the initial pressure, when the exhaust valve would open and the steam be allowed to escape. If we calculate the average pressure on the piston during its whole stroke, we will find that it amounts to 59.6 pounds per square inch. This is called the Mean Effective Pressure. Multiplying the area of the piston, 576 square inches, by this pressure, we find that it amounts to 34,329.6 pounds moved a distance of 4 feet, or 137318.4 foot pounds. Thus the work done by 4 cubic feet of steam in the first cylinder without expansion was 57,600 foot pounds, while the work done by the same quantity of steam in the second cylinder, with expansions (or cutting off at 1-4 stroke, as it is called) amounted to 137318.4 foot pounds.

I have already shown you that the work done by the steam in the second or larger cylinder up to the point of cut off was exactly the same as that done in the smaller cylinder carrying the steam the full length of its stroke, viz., 57,600 foot pounds. If we subtract this from the total work done in the larger cylinder, we will find that the work done by expansion equals 137318.4 – 57600 = 79718.4 foot pounds, or a little more than 138 per cent. of the work done previous to expansion; or for every 100 pounds of work done previous to expansion 138 pounds of useful work is done after steam is cut off when cutting off at one-quarter stroke. If we divide the work done after cut off, or by expansion, by the work done previous to expansion, we have 79718.4 ÷ 57600 = 1.3863, and this will be found to be the hyperbolic log of 4, which was the number of expansions. As this ratio is the same with all other pressures as well as with 100 pounds, it is only necessary, when wishing to find the Mean Effective Pressure, to divide the initial pressure by the number of expansions and multiply the quotient thus found by the hyperbolic log, increased by 1. Let me try to explain this more clearly. In the example just given we found that the work done previous to expansion being taken as 1, the work done after expansion (with four expansions) was 1.3863, which, as I stated, is the hyperbolic log. of 4. Adding the work done before cut off to the work done by expansion, we have 1 + 1.3863 = 2.3863. Dividing 100 pounds, the initial pressure, by the number of expansions 4, we have $\frac{100}{4}$ = 25 pounds, and this multiplied by 2.3863 gives us 59.6, which is the M. E. P. of 100 pounds cut off at one-quarter stroke.

Another example: What would be the mean effective pressure in a cylinder the initial pressure being 75 pounds and the steam being cut off at one-quarter stroke. $\frac{75}{4}$ × (1 + 1.3863 = 44.74 + = M. E. P. This is the easiest and most accurate method of finding the M. E. P., the only drawback being that one cannot always have a table of hyperbolic log. handy.

In the illustration which I have given we found that using an initial pressure of 100 pounds per square inch, and cutting off the steam at one-quarter stroke, we had a terminal pressure of 25 pounds. The question naturally suggests itself, is not this 25 pounds per square inch still capable of doing useful work, and if so, why not cut the steam off at a still earlier period and thus utilize the remaining pressure at the termination of the stroke? It is quite true that the terminal pressure of 25 pounds is capable of still doing more work, and the steam could be cut off at one-fifth stroke and have a terminal pressure of 20 pounds (100 ÷ 5 = 20), or at one-sixth stroke and have a terminal pressure of 16⅔ pounds., or at ⅛ stroke, and have a terminal pressure of 12½ pounds. But here the question of cylinder condensation comes in. The difference of temperature between the steam entering and leaving the cylinder, where a great number of expansions are made, is so great that the loss of heat in reheating the cylinder walls more than counterbalances the benefit obtained. It has been found in practice that there is no benefit obtained by expanding the steam more than 6 times in a single cylinder. Where a high pressure and a greater number of expansions are desired, the use for a second, a third, and a fourth cylinder is the only economical way of accomplishing this end, as in the case of the compound triple expansion and quadruple expansion engines; the steam leaving the first or high pressure cylinder at a high terminal pressure, and being expanded in the succeeding cylinders down to the desired point, in which case the variation in temperature between the initial and terminal pressures is distributed between the 2, 3, or 4 cylinders used, and consequently is not so great in any one.

I have already shown you that the work done by expansion, as compared with the work done previous to expansion, is represented by the hyperbolic logarithm of the number of expansions. I will endeavor to explain as simply as possible the meaning of the term "hyperbolic log" and how it may be used in calculating the Mean Effective Pressure on the piston. This can best be done by a card (fig. 1), in which the line A B represents the atmospheric line and also the stroke of the piston, and the vertical lines AC, b D, $b^1$ d, $b^2$ $d^1$ and B $d^2$ the pressure on the piston, steam being admitted to the cylinder. The line CD represents the admission line at D, the admission valve is closed, and as the piston advances the volume of steam in the cylinder increases and the pressure decreases until when b is reached the volume is increased to twice its original size and the pressure has decreased to one-half, represented by the vertical line $b^1$ d. If we now draw the line c d parallel to A $b^1$ we will find that the area of the figure contained within the lines A $b^1$ d and c is the same as the area of the figure contained between the lines A b D C representing the volume of steam before cut off. When the piston has advanced to three-quarters of its stroke $b^2$, the volume will have increased to three times and the pressure will have fallen to one-third the initial pressure, and will be represented by the vertical line $b^2$ $d^1$. Again, we find that the area contained by the




lines A $b^2$ $d^1$ $c^1$ is the same as the area of the figure A b D C, representing the work done before cut off. When the piston has reached the end of the stroke the volume of steam will have increased 4 times and the pressure will have fallen to one-fourth the original pressure, represented by B $d^2$. Connecting $b^2$ $c^2$ by a horizontal line parallel to A B, we find the area of the parallelogram A B $d^2$ $c^2$ still equal to the area occupied by the steam previous to cut-off. The pressure at any intermediate point between the point of cut-off and end of stroke can be determined in the same manner.

If we now join the points D d $d^1$ and $d^2$ by a curved line cutting all these points, we have what is usually called the expansion line or curve. The figure contained between this curved line and the lines B d D is called a Hyperbola. If we carefully measure the area of this hyperbola, we will find that it is 1.3863 times the area of the parallellogram A b D C, and consequently the work done by expansion is 1.3863 times the work done previous to cut-off. As this proportion is the same in all cases when steam is cut off at one-quarter stroke, no matter what the initial pressure may be, we can use it in all cases. And this proportion is called the Hyperbolic Log. of the number of expansions. The hyperbolic logarithms of numbers are computed by multiplying the common logarithm by the constant multiplier 2.302585. In the same manner as I have described it will be found that cutting off at one-fifth stroke, or with five expansions, the hyperbolic log is 1.6094 equal the hyperbolic log. of 5, etc.

It must be remembered that in the illustration which I have given the expansion curve is the theoretical curve. In actual practice it is almost impossible to obtain such a curve owing to the variation in temperature at the different points of the stroke, cylinder condensation and other causes.

The use of hyperbolic logs. affords one of the simplest and easiest methods of determining the Mean Effective Pressure on the piston of an engine. In using this method it is necessary to first find the number of expansions; this is done by dividing the length of the stroke by the distance travelled by the piston before cut-off. Dividing the initial pressure by number of expansions will give the terminal pressure, and this multiplied by the hyperbolic log. increased by 1 will give M. E. P.

Example: What would be the Mean Effective Pressure on the piston of an engine, initial pressure being 80 pounds gauge, pressure cut off at one-quarter stroke? Cutting off at one-quarter stroke would give four expansions, and 80 pounds (initial pressure) divided by 4 equal 20 pounds as the terminal pressure. The hyperbolic log. of 4 equals 1.3863 which represents the work done by expansion, and this increased by 1 (the work done previous to cut-off) equals 2.3863; multiplying the terminal pressure, 20 pounds, by 2.3863 equals 47.726, which would be the Mean Effective Pressure required.

In calculating the M.E.P. of a compound or triple expansion engine it is only necessary to reduce the H.P. and intermediate cylinder to terms of the L.P. cylinder and proceed as if the total expansion took place in one cylinder.

## ONTARIO ASSOCIATION STATIONARY ENGINEERS

The yearly meeting of the Ontario Association of Stationary Engineers was held in Berlin on May 7th, opening at 11.30 a.m. A letter of regret was read from the president, O. P. St. John. Reading of minutes, reports of officers and last year's committees, and appointment of new committees was accomplished before lunch. The report of the registrar, J. G. Bain, showed over 1,000 names on the books. Upon re-opening at 2 p.m., the report of the Committee on the Good of the Order was received and fully discussed and finally passed. Their recommendations were principally along the lines of strengthening the means to secure prompt renewals of certificates each year. The Legislation Committee reported in full the work done for license law during the last session of the Ontario Legislature, stating to the members that an amendment to the Factories' Act had been passed making it compulsory that all boilers coming under the Act be inspected at least once a year, and recommending the appointment of a committee for the purpose of waiting upon the Government concerning the kind of inspection to be made, and to assist in any legitimate way in carrying out the law.

The election of the four members on the Board resulted in the re-election of Thomas Elliott of Hamilton, and A. Ames of Brantford. The new members were Charles Moseley of Toronto, and George Fowler of Toronto. The election of officers resulted as follows: President, Thomas Elliott, Hamilton; vice-president, F. W. Donaldson, Toronto; registrar, J. G. Bain, 113 Yorkville avenue, Toronto; treasurer, A. M. Wickens, Toronto.

CANADIAN

# ELECTRICAL NEWS

AND

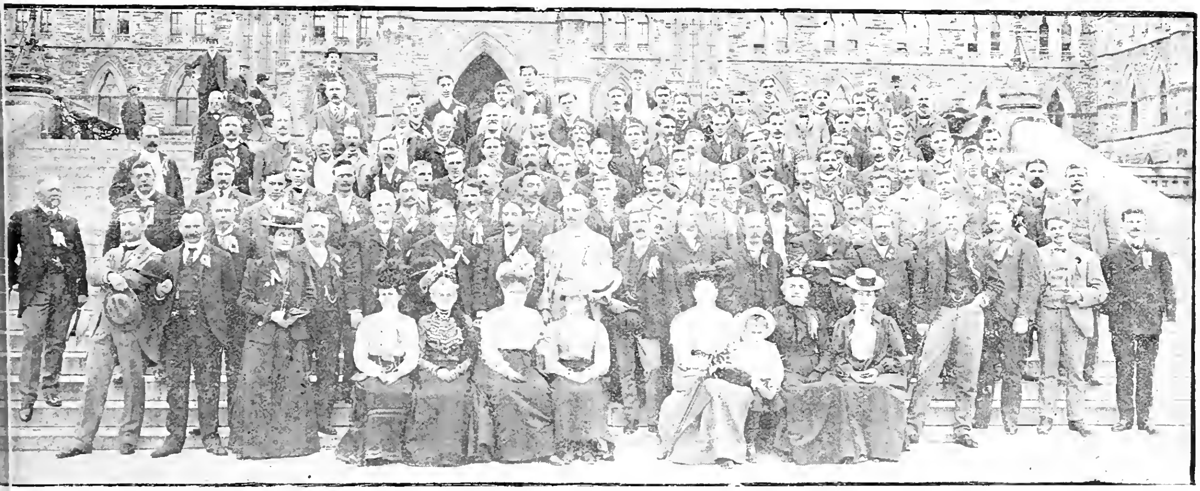
ENGINEERING JOURNAL.

VOL. XI. JULY, 1901 No 7.

## WATER TUBE BOILERS IN THE BRITISH NAVY.

The committee which was appointed by the British Admiralty last year to advise upon the subject of modern types of boilers for the Navy, have recently issued an interim report recommending that further trials be made of four different types of water tube boilers, the Babcock & Wilcox being mentioned first on the list. The committee advise that the Belleville boiler should be discarded for all future ships, already ordered.

The Babcock & Wilcox water tube boiler has been tried for some time in the Navy with very good results and the Admiralty have recently ordered additional Babcock boilers for some of the new ships now building. This type of boiler has been in use by the United States Navy for a number of years with very satisfactory results, and all the new cruisers now authorized by Congress are being fitted with it. Elaborate trials under all conditions have, it is claimed, shown the Babcock marine boiler to be superior in design and construction to other types of water tube boilers, and it seems almost certain that this will be the boiler to be adopted for naval purposes in future. There is every evidence also that, in view of the ever increasing steam pressures required for giving the best economy with engines of large power, this type of boiler is destined before long to entirely supersede the Scotch marine boiler, as one of its special features is the fact that it can be made for any pressure up to 500 pounds per square inch, and will work satisfactorily at this pressure. A large number of these boilers have already been installed in the Mercantile Marine, and we understand the Allan Line have several of them on their ships.



CANADIAN ELECTRICAL ASSOCIATION CONVENTION, 1901.—GROUP PHOTOGRAPH OF MEMBERS AND VISITORS, ON THE STEPS OF THE PARLIAMENT BUILDINGS, OTTAWA.

## NOTES.

After a prolonged discussion upon the tenders submitted for the city lighting of Montreal, the council decided to call for new tenders in September.

The New York offices of the Manhattan General Construction Co., manufacturers of the Manhattan arc lamp have been removed from 11 Broadway to 120 Broadway.

A new board of directors has recently been appointed by the North Shore Power Co., Three Rivers, P.Q., comprising the following gentlemen: F. F. Farmer, Three Rivers, P.Q., president; E. C. Cresley, Bruthleboro, Vt., vice-president; J. B. Fregeau, Three Rivers, Que., managing director; E. Hargrove, Sherbrooke, Que., secretary-treasurer; Warren Curtis, New York; S. Stevens, Stanstead, Que.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2290.

### *ADVERTISEMENTS.*

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

### *SUBCRIPTIONS.*

The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for \$1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union \$1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

Subscribers are requested to promptly notify the publishers of failure or delay in the delivery of the paper.

### *EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

## CANADIAN ELECTRICAL ASSOCIATION.

### OFFICERS:

PRESIDENT:
P. G. GOSSLER, General Superintendent and Electrical Engineer, Royal Electric Co., Montreal.

1ST VICE-PRESIDENT:
B. F. REESOR, Manager Electric Light & Power Co., Lindsay, Ont.

2ND VICE-PRESIDENT:
EDWARD SLADE, General Superintendent Jacque Cartier Light & Power Co., Quebec.

SECRETARY-TREASURER:
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W. H. BROWNE, Manager Royal Electric Company, Montreal.
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A. A. DION, Superintendent, Ottawa Electric Co., Ottawa, Ont.
JOHN MURPHY, Ottawa Electric Co., Ottawa, Ont.
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## ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

EXECUTIVE COMMITTEE.

| | |
|---|---|
| President, G. C. MOORING, | Toronto, Ont. |
| Vice-President, CHAS. MOSELEY, | Toronto, Ont. |
| Secretary, A. M. WICKENS, | Toronto, Ont. |
| Treasurer, W. OELSCHLAGER, | Berlin, Ont. |
| Conductor, GEO. DAWSON | Hamilton, Ont. |
| Door Keeper, JOHN M. DIXSON | Toronto, Ont. |

**The C. E. A. Convention.** In many respects the Convention held at Ottawa last month was the most important meeting since the Association was organized. The attendance exceeded that of any former meeting, and was thoroughly representative of the Provinces of Ontario and Quebec. The papers were of a high order. They received a careful hearing and evoked considerable discussion, and would no doubt have elicited more but for the exhaustive manner in which the subjects were dealt with by the authors.

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A wise step has been taken in amending the Constitution to provide for a class of student members. The young men who may be expected to avail themselves of the privilege of student membership are a desirable class, and after graduation will probably apply for full membership and take an active part in the affairs of the Association. Student membership has been established in several of the American Scientific Societies as well as by the Canadian Society of Civil Engineers, with satisfactory results, and there is no reason to doubt that the Canadian Electrical Association will have a similar experience. Another important change in the Constitution is that which provides that persons engaged in the sale of electrical apparatus and supplies shall not in future be eligible to office in the Association. This amendment met with unanimous approval, the consensus of opinion being that the executive management of the Association should be placed excusively in the hands of persons connected with the management and operation of electric light and power, telephone and telegraph companies.

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The Convention also gave its hearty approval to the resolution introduced by Mr. Higman which provides that in future the funds of the Association shall not be used for entertainment purposes. The adoption of this resolution does not mean that the annual association banquet shall no longer be a feature of the Conventions, but that those who may desire to participate will be under the necessity of purchasing a ticket. In adopting this rule, the Association is falling into line with other organizations of similar character. A better use will no doubt be found for the Association funds which have hitherto been expended for entertainment.

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The admission of about sixty new members at this Convention is an encouraging evidence of growth in popularity and influence. The management for the ensuing year has been placed in experienced and careful though progressive hands, so that the future seems bright with promise. The selection of Quebec as the place of next meeting was made in response to a very cordial invitation from the electrical companies of that city. No doubt there will be a large gathering of the members and their friends to inspect the many interesting sights of the Ancient City which may be seen side by side with some of the most modern developments in electricity. The Quebecers have a reputation for hospitality equal to that of the citizens of Ottawa, which leaves nothing more to be said.

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**W. C. Hawkins, formerly with the General Electric Company at Schenectady, N.Y., has been appointed general manager of the light and power departments of the Hamilton Electric Light and Cataract Power Company.**

# Canadian Electrical Association

## Proceedings of the Eleventh Convention

THE Eleventh Convention of the Association convened at the Russell House, in the City of Ottawa, on Wednesday, June 19th, 1901, at 10.15 o'clock, a.m., the president Mr. A. A. Dion, in the chair.

The following members registered as being in attendance:

W. H. Browne, P. G. Gossler, F. H. Leonard, jr., Alfred Collyer, R. M. Robertson, G. W. Wright, K. B. Thornton, W. F. Dean, A. G. Grier, Alex. Barrie, Cecil Doutre, Geo. H Olney, N. A. Stinson, G. R. Duncan, J. A. Douglas, E. E. Cary, W. B. Powell, D. Sleeth, J. A. Burns, R. E. T. Pringle, J. P. Thompson, F. N. Fairman, Fred Thomson, R. B. Owens, J. M. Leamy, A. Milton Smith, Robt. A. Ross, Thos. Rodger, Montreal, Acton Burrows, A. B. Smith, E. D. McCormack, J. W. Campbell, H. G. Nicholls, H. A. Moore, Geo. J. Hicks, J. J. Wright, C. H. Mortimer, Wm. L. Aldrich, E. B. Biggar, W. S. McLeish, B. G. McBurney, Wm. McCaffrey, Geo. Angus, F. Nichols, James Kynock, B. F. Selby, Toronto; W. G. Bradley, Ben. Baldwin, T. R. Neville, C. T. Thomson, P. C. Marchaud, John Murphy, C. H. Courselles, Wm. A. McDuff, E. J. O'Reilly, W. Ahearn, D. R. Street, R. Anderson, A. E. Caron, Hector Dion, Geo. F. Macdonald, T. L. Richard, W. B. Morrow, W. Y. Soper, Thos. Ahearn, Ormond Higman, Geo. F. Burk, E. P. Featherstonhaugh, Ottawa; P. H. Hoover, Mr. Bliven, New York; R. B. Hamilton, G. A. Powell, St Catharines; F. W. Martin, W. J. McLaren, Hamilton, Ont., R. J. Smith, Perth, Ont.; V.B. Coleman, Port Hope, Ont.; J. A. Robertson, Vankleek Hill, Ont.; H. B. Kirkland, Chelsea, Mass.; H. O. Fisk, Peterborough, Ont.; A. Sangster, R. N. Robins, Sherbrooke, Que.; Frank Houghton, Cleveland, O.; Geo. U. G. Holman, L. Denis, Quebec City, L. H. Reesor, St. Mary's; J. E. Skidmore, Cobourg B. F. Reesor, Thos. Sadler, Lindsay; E. S. Reynolds, Philadelphia; G. L. Kitchen, Newmarket; J. M. Brown, Carleton Place; E. J. Kely, Merrickville, W. R. Taylor, Aylmer, Que.; J. W. Purcell, Walkerville; John Yule, Guelph; W. A. Layman, St. Louis, U.S.A.; D. A. Starr, Cornwall; A. S. Carswell, Pakenham; Raoul Girouard, Smith's Falls.

The President, Mr. A. A. Dion, in opening the Convention, said:

Gentlemen, the programme for this morning was to be a civic welcome by the Mayor of Ottawa. Owing to the fact that several members will not reach the city until the noon train it was thought advisable to postpone the welcome from the city until the opening of the afternoon session at 2.15. This was agreeable to the city authorities and it is arranged to do that. I would advise you, however, to be here pretty sharp on time this afternoon at 2.15 so as not to disappoint the Mayor and other aldermen of the Reception Committee of the City Council who will be here to greet you.

An unfortunate mistake was made in expressing the papers of the Secretary-Treasurer from Toronto by the Canadian Express Co. instead of the Dominion Express Co., consequently they will not be here until about eleven o'clock, so that he has not got the register of the members or his minute book or report. Nevertheless I thought it would be too bad to lose the whole morning, and we might skip these items on the order of business and go on with other matters filling in the morning, so that at the opening of the afternoon session we could go on with these things which we will have to lay aside this morning.

The second item on the programme is an address by the President of the Association. I may say, gentlemen, that this was put on the programme in accordance with a custom which has held in this Association that the President should make a formal address at the opening of the Convention. I may say it is not my purpose this year to take up your time with any formal address. This address which usually covers the progress of electrical science and industry throughout Canada during the past year, loses considerable of its value from the fact that all these items recording the progress of science and industry in this country are regularly reported in the lay and technical press and we are all familiar with them, so that any review which I might make would only be a repetition of something you have already read or heard. I may say, however, that I am exceedingly pleased to meet so many of you in this my own city to attend the Electrical Convention. Last year on account of the fire which had taken place the convention was removed to another place to my great regret, and I am only too glad that I am now given an opportunity to redeem the promise we had made before of giving you a reception in our own city. The programme will show you that some little entertainment has been provided for you. We have tried to arrange it so as to fill in the leisure time and not to interfere with the business portion of the convention. I trust when you go away from this city you will carry with you very pleasant memories of your sojourn here.

The list of papers which you have before you is a very interesting one, and I trust these will receive very full discussion at your hands. It was desired, as in former years, to have these papers printed and placed in your hands sometime before the opening of this meeting in order that you might make yourselves familiar with them and come prepared to discuss them. I can say for Mr Gossler, the Chairman of the Committee on Papers, that he has used every possible effort to have that done, but it is a very difficult task. It was almost impossible to get a manuscript from those who prepared them in time; the result was the papers were placed in print at eight o'clock last evening, so that if we have them here printed at all it is due to the diligence of Mr. Mortimer, as they reached him only at that late hour.

Some of the papers are very timely and I would like them specially discussed. One of the papers refers to rates for electric light. This is not a new subject, but one of increasing importance. Another subject for discussion is also on the same lines, as to the best system of charging for induction motors. It is evident that some of the older plans of charging for electric light and power are often cumbrous and not equitable in every sense, and there has been a desire during the last few years on the part of electric companies throughout America to devise systems of charging which would be equitable both to the supply company and to the consumer. A great deal has been written and several papers have been read in other societies on this subject, and I am glad to say that we will have some discussion on the matter. It is a thing that everybody can speak on and I trust will be fully discussed, so that we may all gather some valuable information from our meeting.

I declare this meeting now open for business and I trust we will have a full attendance at all the sessions. The next item is the reading of the minutes, which will have to be dispensed with for the reasons I have given, also the report of the Secretary. The next item will be the reports of committees.

Mr. J. J. Wright, on behalf of the Chairman, Mr. R. O. McCullough, presented the report of the Legislative Committee, as follows:

REPORT OF LEGISLATIVE COMMITTEE.

Gentlemen:—Since your convention of last year, the Legislative Committee has had its hands pretty full. While no direct attack was made on what is generally known as the Conmee Act, the City of Toronto introduced

a bill to be relieved from its provisions, and after much discussion in regard to the construction of a private act of the Consumers' Gas Company and its conflict with the Connee Act, an Act was passed, the practical effect of which is to provide that the Municipality of Toronto is not within the provisions of the Connee Act, as far as the Consumers' Gas Company is concerned on the establishment of a municipal gas plant within the municipality. It was feared that the introduction of this bill by the City of Toronto would lead to a reconsideration of the principles of the Connee Act, and accordingly such steps as were thought necessary to protect these principles were taken with favorable results.

The most important matter your committee had to deal with was the assessment question. As you are aware, since what is known as the Scrap Iron Decision, there has been constant agitation on the part of various municipalities in the Province for the introduction of an Act to repeal the Assessment Law and enact such legislation as became necessary to do away with the effect of this decision, and the Provincial Government recognizing the justice of this, appointed a Commission to deal with the whole question of assessment. It was thought advisable that this Association should be represented before the Assessment Commission by Counsel so that the case of the Electric Light Companies should be properly presented to the Commission. Mr. W. M. Douglas, K.C., of Toronto, was retained by your Committee and attended at the several sessions of the Commission. Your interests were well and carefully attended to and your case fairly and properly presented to the Commission, at a comparatively small cost. It may be stated here that electric light companies do not object and have never objected to a fair taxation, and so far as the Committe is aware, no electric light company has taken advantage or sought to avail itself in any way of the Scrap Iron Decision. The Assessment Commission, finding itself unable to conclude its inquiries on the general question of assessment in time to make its report to the Legislature in session, made an interim report to the Government, dealing with the assessment of companies having franchises or quasi franchises from Municipal Corporations. It recommended the enactment of a law providing that all the property of such companies shall be taxed first on the value of the land and then on the value of the buildings or works thereon, on a basis of the cost of their reproduction, all wires, poles, gas mains or other property of the company being included. The Government then introduced a bill to repeal the Act on which the Scrap Iron Decision was based, and also at the same time, a other bill with a measure of relief to the companied affected, but when the matter was discussed in Parliament, it was found to be larger question than at first considered and was left over until the next session, and both these bills were withdrawn.

The Assessment matter then is practically in the same position as formerly, with this exception, however, that it is certain to be dealt with fully at the next session of the Legislature. Your Committee feels that it would be a great hardship, especially on small companies, to be taxed to the limit on a basis of cost of reproduction, that no reasonable objection should be made to taxation based on the gross revenue of the company or totaxation on the value of the plant and works in the same proportion as other manufacturing plants in the same municipality. It will be necessary for the Association to take active measures for the proper presentation of its views to the Government and also the Assessment Commission, and I believe it is right for the Committee to state here that considering the very important work carried on by this Committee and the incalculable benefit derived from its work by the various electrical companies belonging to this Association, and the unselfish and arduous labors of the members of the Committee at their own expense, that the campanies interested do not and have not properly supported the Committee financially. At your convention last year, a motion was carried referring the matter of raising money for legislative purposes to the Executive and Legislative Committees. These Committees met and engaged a canvasser in the employ of Mr. Mortimer at fixed charge per company visited, but the results obtained were to say the least very disappointing. The total amount raised during the year was $253.00, which after deducting last year's deficit of $32.86 left $220.14. The expenses for the year have not been large. They amount to $227.86, which leaves a deficit of $7.72. The disbursements are as follows:

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|---|---|
| For telegrams, postage, stationery, printing exchange, services of canvasser, etc | 47.51 |
| For legal services | 180.35 |
| Total | $227.86 |

The number of companies and individuals who have contributed this year is 23; last year the number was 76. The names of the contributors are as follows:

Trenton Electric Co., Renfrew Electric Co., Strathroy Electric Co., Knight Bros. Co., Burk's Falls; James Playfair, Midland; W. H. Birchard, Aurora; Smith Fall's Electric Co, Hamilton & Prout, Forest; Henry Cook, Hensall; Wingham Electric Co., Merrickville Electric Light Co., Ottawa Electric Co., R. A. Corbett, Port Hope; Brantford Electric & Operating Co., Guelph Light & Power Co., Citizens Telephone & Electric Co., Rat Portage; Ingersoll Electric Co., Galt Gas Light Co., Petrolia Elecĉric Light Co., Gananoque Electric Light Co., Wm. Moore & Son, Meaford; St. Thomas Gas Co., Jos. Knox, Stayner.

Your Committee desires to urge the absolute necessity of greater financial assistance, as the work next year is of the greatest importance. It is reasonably certain that some effort will be made against the Connee Act and the Assessment question demands your earnest, undivided and unceasing attention. It is unfortunate that so important a question as that of assessment should come before the House at the last session of the existing Parliament, as the members may be influenced in their deliberations by the prevailing antagonism to corporations. This leads your Committee to again emphasize the importance of this question and the desirability that the companies should take immediate action towards protecting their rights, in some measure at least.

Your Committee desire to express their acknowledgement to these who have so ably and generously assisted in protecting at their own expense the rights and interests of the companies.

R. O. McCulloch,
Chairman Committee on Legislation.

The President: The report is before you, gentlemen, for consideration. The Committee has raised an important question, that of furnishing adequate support to the Legislative Committee for the carrying on of its important labors, and I think it is a matter that oughttobe dealt with. If anyone has any explanation to offer or any reasons to give, or any suggestions to make as to a better way of handling this subject we would be very pleased to hear from them. It is certain that the Legisthis year, andnextyear must be cintinued as q permanent nent committee to watch our interests, and they must have ways and means. If the means they have adopted so far have not been adequate we should discuss some other way of getting them. The Legislative Committee are doing our work collectively in a better way than we can do it individually, and this matter should be fairly considered.

Mr. John Yule: The situation at present in Ontario in regard to the interest of the lighting companies is very serious. The next session of the Legislature is the last session. It practically amounts to an election campaign, and there is great danger of the Opposition taking up the cry and making it a part of their platform that the present Government has been the creature of the corporations, which it has not been. This report is very full, but it does not embody a quarter of the work that has been done. Every member of the Committee has been at a large financial outlay that is not charged to the funds subscribed at all. I am so much disgusted with the support we got from the companies that I feel like dropping the thing and letting them take care of themselves; and if the members of the Committee were to leave the whole

thing alone severely for a year or two we would be back in a worse position than we were before. I claim our labors have been of great financial value to the companies of Ontario. You know how many companies have been bought out, after arbitration, and these simply represent the amount of money that has been paid by municipalities to those companies. If we had not succeeded in getting our interests properly represented before the Government every company that has been transferred would simply have been wiped out. The feeling of the municipalities and average aldermen is that they should put in their own plant and go into competition with the existing companies. I donjt know that I can say enough to impress upon the companies the importance of this thing and of continually watching and guarding. If they only knew what work we have done they would look at the thing in a proper and more liberal spirit.

**Mr. B. F. Reesor**: Mr. President, I don't know that I can add very much to what Mr. Yule has just said. I am as satisfied in my own mind as I am satisfied of anything that had it not been for the Conmee Bill passed and in existence to-day, every company or individual that has been in the electric light business and has been bought out by a corporation would not have been bought out, but would have dropped out of place, would have been swamped and ruined. As far as our town is concerned, we feel that very keenly. We are in probably a unique position; we have not had any street lighting for almost a year. There has been a fight going on there ever since and we are satisfied that had it not been for the Conmee Bill we would have had the opposition of the corporation; the corporation would have gone into lighting on their own account. As it is now, we are sustained by the Conmee Act and we are in that position that before the corporation can go into lighting on their own account they have got to buy us out. I don't think they propose to buy us out at all, but at the same time that is the position we would have been in, and we would have had a corporation plant put in there and our plant thrown in the scrap pile; and I feel, as a member of the Legislation Committee, very keenly that we have not been supported by the electric companies and these interested the way we should have been. There is nothing for it that I can see other than to go on in the way we have been going. I can't conceive any better way of raising and devising ways and means for subscribing than the way it has been done. If any member of the Association can suggest something better I would be pleased to hear it.

Mr. W. H. Browne: Mr. President, I have somewhat arrived at the impression that the efforts of the canvassing committee for the procuring of funds for the Legislative Committee for the past year, have been confined largely to the companies in Ontario only, and they have seemed to treat this matter as an Ontario one. I find in looking over the report of last year that Mr. Yule's idea was that a canvasser be engaged to visit all the companies and get them to sign an agreement to contribute a specific amount for five years. I am not aware that that suggestion has been acted upon. We in Quebec, although not menaced by the same spirit that seemed to prevail prior to the passage of the Conmee Act, must necessarily anticipate in the future legislation of some kind; and I presume it would extend to other portions of the Dominion as well, and we certainly should not be left out for contributions to this fund. I may say the Royal has been ready to do its part.

Mr. John Yule: There was one company which came into Canada, an American company, whose interests in Canada are not at present affected at all, but they very generously, and with a good deal of foresight, said, "we are not affected at present, but we can see if this thing is going to go on it will not be long before we are affected, and we are prepared to support you in your fight." It seems galling to me that people that have received the benefits of our work never even gave us a dollar or wrote us a letter. As to the agreement, it was decided to call for it for three years instead of five. We thought five years was too long ahead and we made an effort to get a three years' agreement. I would ask the Secretary have all those who signed the agreement paid the draft that was sent out for the assessment?

Mr. C. H. Mortimer: I think so, as far as I know. Where drafts have been made they have been paid. The draft was only made for one year's assessment. I think the great majority of them paid the drafts.

Mr. B. F. Reesor: This canvass that was spoken about in the last year's report was not made, was it?

Mr. Mortimer: Western Ontario was pretty thoroughly canvassed; and when the canvasser started out again this year I asked Mr. McCullough if we should continue that work, and Mr. McCullough said no, so that nothing has been done in Eastern Ontario.

Mr. J. J. Wright moved, seconded by Mr. B. F. Reesor, that the report of the Committee on Legislation be adopted. Carried.

The President: The Committee on Standardization of Accounts, of which Mr. Hart was chairman, and which committee exists for two years, had done some work in the first year and obtained some additional data during the last year from which Mr. Hart was to prepare a report to submit to this meeting. Mr. Hart is not here this morning; he may be here later, and as there are other committees to report, we might possibly have a report from the Standardization Committee at a later session.

The President called for the report of the Committee on Rating of Arc Lamps.

Mr. O. Higman: There has been no meeting of the Committee. The understanding was that as arc lighting was at that moment in a transitory state we should delay action in the matter of a standard until some future time.

I might say that during the last session an amendment was made to the Act giving power to create a standard for arc lighting, and if this Committee is continued they can get to work now, with the assistance of the Department, and make such standards as they deem necessary.

The President appointed as the Nominating Committee to strike the standing committees for the coming year Messrs. W. H. Browne, Montreal; J. J. Wright, Toronto, and Mr. B. F. Reesor, Lindsay: with instructions to report to-morrow as to the standing committees for the year.

The President: The next item will be the reading and discussion of papers.

Mr. K. B. Thornton, Montreal, read his paper on "Notes on Construction and Protection of Aerial Transmission Lines," which was greeted with applause. (See page 142.)

The President: You have heard a very able and interesting paper on a very practical subject, and treated in a very practical way—the kind of paper that many members of this Association have been asking for. I think we are indebted very much to Mr. Thornton for presenting it and treating the subject in such a complete manner. It is now open for discussion and I hope it will receive a very full consideration.

Mr. W. H. Browne: Mr. Thornton has treated this subject practically and well. I hope, however, it will not be allowed to drop without submitting him to some questioning as to further light wanted upon it.

**Mr. B. F. Reesor**: I do not think it is fair that this paper should be presented without discussion. For myself, I feel very highly complimented in the way the paper has been gotten up; I fancy Mr. Thornton must have been over our transmission line (laughter). Our transmission line is carried out to the letter, almost in accordance with Mr. Thornton's ideas, with perhaps one or two exceptions. He speaks of a rubber covered wire. Our transmission line, which is fourteen miles long, is a bare wire. In another place he speaks of barb wire on the cross-arm; we have not got barb wire on the outside of the cross-arm, we have it on the top of the pole, but it is put on with staples instead of an insulator; and then where he grounds every pole we ground every other pole, and we have fifty-six poles to the mile. I am a little opposed to the barb wire lightning arrester for the reason, perhaps, that there is a danger of the barb wire dragging or breaking and getting tangled up with the

live wire, although we have had no difficulty whatever so far, neither have we had any difficulty with lightning discharges. Those we have had, have been taken care of whether the barb wire has done this or not, we do not know, but we will give the barb wire the credit. Otherwise I think the line Mr. Thornton builds, mentioned in his paper, is one of probably as good construction as could possibly be put up. I think the depth of the holes and the poles are about uniform with what we have been using. The size of our poles is seven to eight inches at the top, and five feet was our standard for depth of hole. We guyed our poles at every turn and then guyed endwise at short distances as well. On our line we have a metallic circuit telephone line under the transmission line. We transpose the telephone line every fifth pole and it has given us eminent satisfaction. The induction is nil. We can talk over fourteen miles without any difficulty; it is simply perfect. Our voltage transmission is 10,000 volts. I hope this paper will be fully discussed.

Mr. P. G. Gossler: It is particularly interesting to me to hear Mr. Reesor's experience with his barb wire protection. I think it would be very beneficial and certainly instructive to hear the result of the experience in other plants. The experience we have had on the Chambly line has been exceedingly satisfactory, and I think demonstrates clearly the safe-guard that barb wire as a lightning protection affords. When our line was first constructed it was intended to have the ordinary air gap arresters located at each place where aerial lines were connected with the cable, as it has been shown in a great many cases that there is liable to be trouble where aerial lines are connected with underground cables. This was not done as the arresters were not available in time and the line was put into use without them; we therefore anticipated considerable trouble at the points in the transmission lines, where the aerial and underground systems joined. The first storm that came along, came about midnight, and I think we were all pretty well scared because we expected to see the cables break down. The barb wire, however, fixed that, and we ran one entire summer, through a season when, according to the records of McGill College there were more storms than for three years together for the past seven years. Since that time it was thought inadvisable to place air gap lightning arresters where the aerial and cable sections joined, inasmuch as they would necessarily be some distance from the station and not under constant observation. I should like very much to hear the experience of other companies in connection with the barb wire protection.

Mr. F. W. Martin: In Hamilton we have a 22,000 volts transmission and we have run the best part of this summer without the lightning arresters on at all. It is a question with us whether it would be advisable to put the air gap lightning arrestor on. We have had storms up there, and didn't know whether it would be any improvement to put them on or not, in fact, my own idea would be to leave the air gap lightning arresters off.

Mr. P. G. Gossler: About six weeks after we put the transmission line into use there was one very severe storm which occurred early in the evening when we could see the storm travelling. The storm struck Montreal first and simply demoralized the local distribution system, and then started in a direction due east, which would be right towards Chambly, following along our main transmission line. We were fortunate enough to not have our telephone communication interrupted, and followed the progress of the storm till it got to Chambly. When it got there, there were several local lines which were simply paralyzed and all the transformers destroyed; however, during that entire storm, possibly covering an hour, there was not a single discharge on the 34 miles of transmission line. That seemed to us almost conclusive—it was conclusive evidence of the protection afforded by barb wire, and as shewn on those lines was a very reliable safeguard. I may say for the three seasons that line has been in use there has never been a single discharge on the line or any interruption whatever.

Mr. B. F. Reesor: We have a six inch plate soldered to every ground wire at the bottom of the pole, and we have on our high voltage line air gap arresters at each end; we have repeatedly seen during a heavy storm a discharge going through these air gaps at the same time our experience has been that while storms were going on and our local lines were punctured and broken down our transmission line was not affected in any way.

Mr. W. H. Browne: The paper and the discussion seems to have drifted to transmission lines. I would like to arouse questions and discussion upon the internal distributing lines within our towns and cities. That, it seems to me, is one of the most important features of our business. The transmission line question, I think, has been practically taken care of. How are we acting in our local distribution work within the citiès? How are we making our connections to our customers premises? How are we avoiding the dangers from lightning discharges and crossings and other things? I would like to arouse some discussion and some question on that line.

Mr. Campbell: I think this gentleman deserves to be congratulated for the very important paper he has presented, and as a suggestion I would think it would be wise to have that paper published and handed to every electrical company in the country for the benefit of their engineers at large. While I do not wish to prolong the discussion on transmission lines, there was one point I wished to refer to, and that was barb wire as used on the very large transmission lines, take the line from Niagara Falls to Buffalo. I understand that they used barb wire originally and abandoned it. Mr. Thornton speaks in his paper about some engineers taking exception to the use of barb wire. He probably has a reason for making that remark, and I would like to have an explanation from him as to what information he has on it. The paper as a whole is a very important one and one which is undoubtedly useful to everyone connected with the Association.

Mr. O. Higman: Mr. Thornton is certainly entitled to our thanks for the very able paper he has given on this subject. There is just one feature connected with the line that I would refer to, and that is the grounding of the poles as a protection from lightning. At least 30 years ago the International Electric Company of Great Britain, when building their line, invariably placed a ground wire on every alternate pole, and it was a most unusual thing to see a pole destroyed by lightning. In this country where there has been no such practice I have known as many as ten or twelve poles consecutively destroyed, splintered by lightning. Mr. Smith will bear me out in this.

Mr. A. B. Smith: That was in the old days.

Mr. Higman: It was only a few years ago it was not the practice to ground poles. I think it is an excellent method of protecting the poles from destruction by lightning.

Mr. H. A. Moore: I would like to ask if any of the members have the data in connection with the use of any other wire than barb wire in particular as a protection to the lines? The big objection to the use of barb wire seems to be its lack of good mechanical properties and its liability to corrosion, and the generally poor quality of the iron in barb wire. I was connected with a company for a few years which operated a transmission line and a distributing line as well, and on the local distribution circuits the arc circuit paralleled or ran above the distributing circuit nearly all over the town. In four years there were only one or two discharges through the arresters on the alternating circuit, but during every lightning storm which visited the locality the arresters on the arc circuit went off repeatedly at almost every discharge. I would like to know if any of the other members have had experiences along similar line, and whether it is not possible that an iron wire or a wire of some other metal of far better mechanical properties than barb wire could not be used as a lightning protection.

The President: This discussion is very interesting. I came here with the impression that barb wire as a protection for transmission lines was not, to use a common expression, what it is cracked up to be. I have read of

several instances where it was said that barb wire by breaking frequently and causing line troubles, had become such a nuisance it had to be abandoned. I am very glad to hear from others here to-day that barb wire is an effective protection against lightning and that the line troubles through its use have been exaggerated. From the evidence we have heard here to-day I would think the protection of long distance transmission from lightning was pretty well solved. There is that very important point raised by Mr. Browne, the protection of internal distribution lines throughout the city, which is not solved. This is a good subject for discussion, as to whether the advantages of the barb wire system can be extended to city lines. If the trouble due to breakage is so great as to prevent the use of barb wire throughout the streets, then why not, as suggested by Mr. Moore, get some substitute, a steel wire or some wire that can be depended upon to stand as much strain as your ordinary wire; then it would seem we might get a more effective protection than we get now. The protection from air gap lightning arresters placed at the station end of the line, in connection with choke coils and supplemented by air gap lightning arresters on other points on the distribution lines, are not an effective protection against lightning. That is the teaching of experience. The station apparatus, to my experience, is pretty well protected, but the transformers are not. Now, it is a very live question and a question which means dollars and cents to all of us as to how to better protect our transformers in the city from lightning discharges; and if we can evolve a system of continuous lightning protection free from the defects which have been charged against the barb wire, we will have done a very important service to all electrical companies in the country. Another point which I took note of is the excellent specification given by Mr. Thornton for the construction of lines. We all see very bad line construction through cities and towns, and I have no doubt that the men who put those lines up are quite capable of putting up good lines if they were only told how to do it, and I think if a specification like this were placed in the hands of all people responsible for building lines there would be a vast improvement in line construction.

Mr. Yule: I would make the suggestion that Mr. Mortimer publish this paper in the shape of a pamphlet and sell it at a small charge.

Mr. J. J. Wright: With reference to using another wire for that purpose, it seems to me that is a very small matter. The barb itself appears to be an essential part in the use of that wire. A plain wire without the barb would not be nearly as effective; but if it is found that the use of this barb wire is effective the balance of the question is a simple one; it is merely a question of a little more money. The only reason why this barb wire has been found to be so effective is simply because it is the every day barb wire of commerce, what the farmer uses to keep his sheep out of the pasture field; it is not intended for this purpose. If it is found that it is a perfect protection it is simply a matter of getting a heavier steel wire or even a copper wire or any other metal that is able to stand the strain. Mr. Browne's query as to the protection of city lines is fully as important as the other. We have no means of protection. We have tried every kind of lightning arresters, yet the only thing we can do is to keep a stock of transformers, and when one goes put up another in place of it.

Mr. Martin: In Hamilton we have tried putting the lightning arresters on the ends of all our lines as well as in the station.

Mr. H. O. Fisk: It seems it would be a good scheme to ground quite a number of these poles that our linemen have to be travelling up and down every day and doing work on, especially in wet weather? It would be rather warm there I fancy at times.

Mr. O. Higman: An idea suggests itself to me. A steel wire might be made with a ragged edge that would take the place of the bit of wire that is tied around, which must be ineffective.

Mr. Martin: Wouldn't it, with the grounded wire, be safer for the linemen?

Mr. A. B. Smith: I want to say that I think this convention ought not to degenerate into a barb wire convention, but I want to say a good thing for barb wire. I remember distinctly a few years ago a terrific storm we had in Western Ontario, extending chiefly from Hamilton to Niagara Falls, and during the night everything in the shape of a telegraph and telephone iron wire went down. The Cataract Power Company's transmission line on the other side of the railway track carried these barb wire arresters with the transmission wire and telephone wires below, and it was a remarkable fact that there was not an atom of sleet on the barb wire, while the other wires were loaded. There is something in that that is worth considering.

Mr. B. F. Reesor: We have no trouble with barb wire, the only objection I have to it is that when it breaks it goes into about forty kinks.

Mr. Martin: Has Mr. Reesor had much trouble with the breaking of the barb wire?

Mr. Reesor. No trouble whatever.

Mr. Martin. I only remember one instance in Hamilton. The barb wire dropped down clear of everything and we only had to cut it out. It didn't stop the service.

Mr. Gossler: I would like to make a reply to Mr. Moore's enquiry for any other companies who have had experiences on their lines in regard to arc wires taking off discharges. We have noticed on our lines throughout the city that there have been more discharges on the lines on the upper portions of the poles. In regard to protection within the city, we are at present making an experiment, and had hoped to have some results ready for this convention. Fortunately, or unfortunately, there have been no lightning storms of any consequence within the last six weeks. We are protecting one circuit in the city by means of the barb wire, and another circuit by means of the air gap lightning arresters. If we have any results before the convention next year which are worth relating we will let you have the benefit of them. In regard to the grounding of the ground wire on the pole, if that was carried out in city construction, and carried to the top of the pole, as it has been in some instances, it would not be safe. It would be unsafe for the men to work. The means of connecting the barb wires to the ground wire as shown in Mr. Thornton's paper I think will do away with any difficulty to be experienced in that way. The ground wire is on the outside of the crossarms and is taken down far enough on the pole so that a man sitting on a brace or cross-arm will not likely come in contact with it.

Mr. Campbell: May I ask Mr. Thornton if he could give any information on that question as to why certain people have discarded the use of barb wire?

Mr. Thornton: I believe that the use of barb wire has been abandoned on the Buffalo-Niagara line, at least it was noted in some of the electrical papers. Their exact reasons for doing so I don't know, but judging from our own experience I should think it is probably due to defective construction in putting the barb wire up. If it is inspected every now and then I think that trouble can be forestalled. We made a minute inspection this year and found where our barb wires crossed over the railway tracks there was some sign of deterioration due to the smoke of the locomotives acting upon the zinc, we simply cut out these stretches and on the whole of the rest of the transmission line there was not the slightest sign of any deterioration or anything we needed to be afraid of. In regard to trouble in winter, last year we had an extremely severe winter in Montreal, and although we had one of our seventy-foot pole lines in the city blown down, we had no trouble at all with the barb wires being broken by sleet or anything else. Mr. Reesor spoke with reference to the telephone line. Our telephone line is below the transmission line, it is not shown on the sketch in my paper. It is hard drawn No. 12, B. & S copper wire run on side blocks. We have a bridging system with somewhere about ten telephones connected with it

and we have no trouble with hearing on the line at all, as the wires are "spun" throughout the entire distance from Chambly to Montreal. We have found with lightning storms that the city is affected in the extremities. A short time ago I plotted out on a map the transformers that were burned out and it showed they were all in bunches in certain sections; they were at the extremities of the lines to the east and west, but in the centre of the city we had very little trouble at all. In the east end of the city we are putting up barb wire on one circuit that runs some considerable distance from the power house. In regard to protecting the grounding wire, we have recently protected it by running a wooden moulding up the pole. As far as the transmission line is concerned, our men do not ordinarily work on it when it is alive; but in the city it is a different thing; we always work on the lines when alive so that the presence of any ground wire is more or less of a menace.

The President: Have you any theory for the occurrence of lightning discharges on the outskirts of the city rather than in the city?

Mr. Thornton: I think it is a well-known fact that the greater strain during a lightning storm is at the ends of transmission lines, that is where we experience most of our trouble, for that reason I said the arresters should always be put at the ends of the lines.

Mr. W. H. Browne: May it not be the fact that the presence in large numbers in the congested portions of the city, of telegraph and telephone wires, which are usually above the electric light wires, may have the same effect in the distribution of lightning discharges as barb wire would on the poles themselves?

Mr. Thornton: I don't think there is any doubt at all that the presence of grounded lines and that sort of thing in the city must be more or less of a protection to lines in the immediate vicinity, and for that reason I think we suffer less in the city. I omitted mention that wherever we guyed to other companies poles or to guy poles we put a strain insulator on every guy. With regard to the men doing line work in the city, there is no doubt about it if you leave them to their own sweet will they will do about the worst work it is possible for them to do. Recently we have been paying a good deal more attention to our line work and have found it advisable to have a good man who will stay right by the gang and instruct them how to do decent work. In regard to Mr. Browne's remarks, I purposely left out the matter of house connections and that sort of thing. That in itself is a large subject and needs almost a paper in itself. It is a difficult job in some cases to make nice work in house connections, especially as it is the practice now for all people in Montreal at least, to wire their houses to the rear, while the poles are on the street, making it necessary to cross over the roofs of houses. In building lines in the city you have got to protect your lines and to put them up in such a way that you will not have crosses between your primary and secondary circuits, and that your primary and secondary wires wont be grounded together on trees. Where other companies are operating in the same city and in the same locality you have got to use additional precautions in order to avoid any chance of trouble. You have got to patrol your lines. We keep one special inspector who patrols our lines day in and day out; and I think the other companies as far as I know all have a special man detailed to do the same work. Although we occasionally have line troubles I think a great many of them are forestalled by this inspector going around and reporting defects and the repairs being made at once before anything serious develops.

The President: It occurred to me while Mr. Thornton spoke of the difficulties of connecting house wires from the rear to a line that is on the street, that it was a very great difficulty that we have all experienced more or less. I would like to know what the practice is in Montreal in regard to that, whether you allow a man to wire any way he likes and you connect with the house no matter where the entrance is, or whether you object to certain ways of making connections, such as going over roofs and so forth.

Mr. Thornton: If a man asks for the rear we connect at the rear. If we didn't the other company would, I suppose. That is where poor line work comes in. You leave it to the ingenuity of the foreman to dodge around chimneys and get over roofs; and some of the roofs are particularly hard to get over. In most of the streets in Montreal the blocks are divided with a lane up the centre. Very often on your nerve you can put poles up a lane, or you can get permission from the proprietors to put poles in the lanes. In that way we can connect from the rear. In some cases we have had to do that; it was simply impossible to connect them from the front. In some cases to avoid interfering with any other company's line we do go considerably out of our way to avoid crossing their wires, and connect to the customers premises. We do not follow any special rule for connecting a customer's premises. It is almost necessary in every single instance to send a foreman and see what is necessary. We thought with our records we could look up and determine the exact position of the customer relatively to our poles and distribution systems and say, you need so much wire; but we found we could not do that. It is necessary to send the foreman and see what is necessary. Nearly all contractors are wiring to the rear, especially in residential sections.

The President: If there is no more discussion I think I will voice your sentiments in tendering the thanks of the Association to Mr. Thornton for the great pains he has taken in preparing this paper. It is a very valuable contribution to the records of the Association.

The President read a telegram from Mr. F. Simmons, of Kingston, regretting his inability to attend the convention on account of the strike in that city.

At 12 o'clock, noon, Mr. J. J. Wright moved, seconded by Mr. John Yule, that this meeting adjourn to 2.15 o'clock p.m. Carried.

### AFTERNOON SESSION.

The President in the chair, called the Convention to order, at 2.15 o'clock.

A telegram was read from Mr. Edward Slade, stating he had been detained by urgent business, but would be with the Convention on Thursday; also a telegram from Prof. Owens, stating he would not be able to be present to-day, and asking that the reading of his paper be postponed until Thursday afternoon.

The President: Gentlemen, it is our privilege to have with us this afternoon His Worship, Mayor Morris, of Ottawa, and Alderman Deering, Chairman of the Civic Reception Committee, who have been kind enough to come down here to greet you as members of the Canadian Electrical Association. I will call upon His Worship to address a few words to you as Mayor of the City of Ottawa. (Applause.)

Mayor Morris: Mr. President and Gentlemen of the Canadian Electrical Association: I was just beginning to wonder if the Electrical Association was responsible for the electrical storm which has just passed over the city, and if so I think it is a very opportune time for gentlemen who are interested in manufacturing to start a barb-wire factory here (laughter). I wish now, as Mayor, to read you a formal address on behalf of the City of Ottawa, as follows:

### ADDRESS OF MAYOR MORRIS.

Ottawa, 19th June, 1901.

Mr. President and Gentlemen of the Canadian Electrical Association:

It gives me great pleasure to welcome you to the City of Ottawa. This is the second time you have honored our city with your presence, and I trust that your deliberations will be as profitable to yourselves and to your profession, now, as they were on that former occasion.

I hope that you will not find the citizens of Ottawa deficient in extending courtesies which although they may not advance the science of electricity very materially, still will go a long way towards making your stay here pleasant and entertaining.

We are given to flattering ourselves here, that as an exponent of what is modern in electrical development, Ottawa leads the van. It is our proud boast (as statistics will maintain) that we have more incandescent lights per capita of population than any other city in the world. The fine street car service that you see here is the outcome of what was the earliest and most daring enterprise in street railway traction in Canada. The fine water power that we have at our front door here, enables us to do, and have, many things that will no doubt prove interesting to you on inspection.

The progress that can be noted here in electrical development is just a criterion of what is going on, on all sides. Everyone knows how essential to our comfort and convenience electrical devices have become. A few years ago, a light of the brilliancy of an ordinary incandescent lamp would be considered much too bright, in fact, injurious; now it has become so much of a necessity that people sometimes find fault with it.

The benefits of a Convention of this character cannot be too highly rated. Most of the startling developments of our time have resulted from conventions of this character. In your daily observations in your power houses and your offices, you see wherein some of your apparatus, or your methods, can be improved upon, or in some way made more efficient. You wish to let some of your fellow-workers know of your improvement. What better way can there be than by conventions of this kind? We all know the results. From the small local station, whose radius of distribution was limited to a mile or so, now we have stations supplying power forty and fifty miles from the source of supply.

There does not seem to be any limit to the development of your science. At the present time wonderful strides are being made in electrical transmission of power over distances, which is destined to do a great deal in developing this country as to manufacturing, and add to the comfort of living. The water power may now be brought to the doors of the factory, and through the much-abused, but highly prized trolley car, the poorest and humblest may take his family to live in the health and happiness offered by country surroundings—where each may, in time, own his little home.

Wireless telegraphy is destined to accomplish wonderful things in war and commerce. The applications of electrical science have become so many and have reached such a state of development, that their treatment calls for a very high order of knowledge. The profession of electrical engineering is certainly one worthy of the best minds, and to the electrical engineers of Canada is entrusted as much as to anyone the mission of developing the resources of our country, of raising Canadians to a higher degree of civilization, and making us all happier and better men.

Let me again repeat my welcome. I hope that your stay in Ottawa, will be such that you will always hereafter hold kindly feelings for us, and if anyone suggests again that a Convention of your Association be held here, you will not be averse to coming back. If such occurs, I can promise that your welcome will be as cordial as the one extended to you to-day.

W. D. Morris,
Mayor.

The President: I have much pleasure in introducing to you Alderman Deering, Chairman of the Civic Reception Committee, and I would ask him to address a few words

Alderman Deering: Mr. President and Gentlemen, members of the Canadian Electrical Association: I asked my friend, Mr. Dion, the other evening when we were discussing the Convention to leave my name off. I am sure after the eloquent address you have listened to by His Worship anything I can add will fall very flat. I must say it gives me a great deal of pleasure to be here to-day to extend to you a welcome from the citizens of Ottawa. We think that we can give a right royal welcome to anyone, and I hope that you will go away feeling that you have been well entertained. We will do the best we can. I hope, if the weather keeps fine until half-past four, to take my part and we will then give you a drive around the city, showing you our best residential streets, and also have a look at the new bridge and several other things, so that I think you will find that your afternoon has been well spent. Thanking you for calling on me, Mr. President, I will take my seat.

The President: I have pleasure in introducing to you Alderman DesJardines, and I would ask him to say a few words to you.

Alderman DesJardines: Mr. President and Gentlemen: The Mayor and Chairman of the Reception Committee have covered the ground pretty well, and there is not much left for me to say. However, I hope I may be of some use to you to give you a good time in our city while you are here, and I will do all I can to entertain you in the best manner possible, and I hope that you will come back to us before long, because we generally love to see good people come to our city; we cannot have too many good friends. I thank you

The President: Your Worship and Gentlemen of the City Council, on behalf of the Canadian Electrical Association, it gives me very much pleasure to tender to you the thanks of the Association for your kindness in coming here this afternoon to offer us a civic welcome to this city. I am sure that all the members of the Association appreciate very highly your kindness in this matter. We thank you very heartily, and we trust that you will find it pleasurable to attend the meetings of this Association to which you are quite welcome at all times until our adjournment. I thank you very much.

The President: The next order of business, which should have been taken up this morning but was postponed on account of the Secretary not having his minutes here, is the reading of the minutes of the last annual meeting. I will call upon the Secretary to read them.

The Secretary read the minutes of the last annual meeting, which were approved and signed by the President.

The President: The next item on the programme is the reading of the Secretary's report.

The Secretary presented his report as follows:

### SECRETARY-TREASURER'S REPORT.

I am pleased to be able to report a steady growth in membership and a widening interest in the Association by the members and persons and corporations interested in electrical matters outside. The valuable work performed by the Legislation Committee has exerted an influence

in this direction, yet many of the companies who benefited largely by this work are yet without the Association. If possible, means should be devised of adding more rapidly to our membership. If the privilege of membership were offered to electrical students in our Scientific Schools at the nominal fee of one dollar per year, as is done by the Mining Institute, it might be the means of inducing yearly additions to the membership of bright young men who in time would pay the regular fees and do valuable service towards advancing the objects of the Association. In this connection it has occurred to me that the Association might also think it advisable to offer yearly a prize to the Third Year Students in the Electrical Department of these schools, thereby manifesting its interest in scientific education, and at the same time keeping the Association and its work constantly before the attention of the young men who will take a prominent part in the development and management of electrical enterprises in the future. These suggestions are offered for what they are worth, to be acted upon or otherwise as the Association in its wisdom may decide.

Since last Convention the Executive Committee has held two meetings, first in Toronto, on October 9, 1900, jointly with the Legislation Committee pursuant to the resolution moved by Mr. Yule and adopted by the Association at the Kingston Convention, and secondly, on February 12, 1901, at the Windsor Hotel, Montreal.

At the first of these meetings action was taken with the object of securing the assistance and co-operation of the electric lighting companies in behalf of the work on which the Committee is engaged for the protection of electrical interests. Further details are omitted as they will probably be given in the Committee's report to this Convention. The President and Secretary were instructed to memorialize the Dominion Government regarding the desirability of establishing under a properly qualified officer a Testing Department, which would be at the service of electric lighting companies on payment of reasonable inspection fees.

At the meeting in Montreal on February 12th, last, the account for printing in connection with the last Convention was approved for payment, three new members were elected, and six resignations accepted, subject to payment of fees to the end of current Association year. Action with regard to resignations of persons connected with the Canadian General Electric Company was deferred until next meeting. Dates for the present Convention were fixed and an appropriation of $150 voted for the use of the Local Committee.

The following Committees were appointed to complete arrangements for this Convention: Committee on Papers and Topics for Discussion: Messrs. Gossler, Slade and Camp. Local Committee: Members of the Association residing in Ottawa, together with Messrs. W. H. Browne, W. J. Camp and A. B. Smith, with power to add to their number.

The advisability of inviting manufacturers of electrical apparatus to exhibit at the Convention was left to the discretion of the President. Mr. Angus was engaged to report the proceedings. The President, Messrs. Wright, Yule and Smith were appointed a Committee to recommend necessary amendments to the Constitution.

The number of members at present on the roll is as follows: Active, 235; Associate, 32; total, 267; a gain of [illegible] since last report.

During the year death removed a useful and much esteemed member of the Association—the late Mr. Charles P. Dwight, who died in Toronto on January 20th, last, at the early age of twenty-nine years.

Following is a statement of the receipts and disbursements:

FINANCIAL REPORT FROM JUNE 1ST, 1900, TO 31ST MAY, 1901.

RECEIPTS.

| | | |
|---|---|---|
| Cash in bank June 1, 1900 | $339 83 | |
| Cash on hand June 1, 1900 | 11 20 | |
| 121 Active members' fees, at $3 | 363 00 | |
| 16 Associate members' fees, at $2 | 32 00 | |
| C. H. Mortimer—To replace Convention buttons lost at Hamilton Convention | 6 25 | |
| Legislation Committee—C.E.A. | | |
| Envelopes used | 1 00 | |
| Loan of cuts | 6 07 | |
| | | $759 35 |

DISBURSEMENTS.

| | | |
|---|---|---|
| Convention Expenses— | | |
| Convention buttons | $12 50 | |
| Grant to Local Committee | 95 00 | |
| George Angus—Stenographer | 35 00 | |
| C. Clement—Assistant to Secretary | 3 00 | |
| "Electrical News" printing account | 94 90 | |
| Cuts to illustrate Convention papers | 23 16 | |
| Ribbon for badges (1900) | 1 11 | |
| Express charges | 1 60 | |
| | $266 27 | |
| Unpaid accounts—1899-1900 | 17 85 | |
| Grant to Secretary | 125 00 | |
| Secretary's travelling expenses to Montreal to attend Executive meeting | 20 00 | |
| Postage | 26 00 | |
| Exchange on cheques | 3 10 | |
| Telegrams | 2 23 | |
| Stationery | 8 60 | |
| Express charges | 75 | |
| Ribbon for badges (1901) | 2 81 | |
| Membership cards (1901) | 4 00 | |
| | | $476 61 |
| | | $282 74 |
| Money in bank June 1, 1901 | $2,6 47 | |
| Money on hand June 1, 1901 | 14 27 | |
| | | $290 74 |
| Unpaid accounts | | 8 00 |
| | | $282 74 |

RECEIPTS.

| | | |
|---|---|---|
| Money in bank June 1, 1901 | $276 47 | |
| Money on hand June 1, 1901 | 14 27 | |
| 44 Active members' fees, at $3 | 132 00 | |
| 10 Associate members' fees, at $2 | 20 00 | |
| | | $442 74 |

DISBURSEMENTS.

| | | |
|---|---|---|
| Printing badges for Convention | $11 75 | |
| Postage on programmes, etc | 20 00 | |
| Exchange on cheques | 2 70 | |
| Express charges | 29 | |
| Telegram | 30 | |
| Stationery | 45 | |
| Money on hand June 17, 1901 | 13 53 | |
| Money in bank June 17, 1901 | 393 72 | |
| | | $442 74 |

Mr. Purcell moved, seconded by Mr. Martin, that the report of the Secretary-Treasurer as read be adopted.

Mr. O. Higman: I have very often been impressed with the fact that we throw away nearly the whole of our membership subscriptions in the annual banquet. Surely an

Association of this kind which claims to be scientific somewhat in its aims must have outgrown the barbarous custom of wasting time and means in mere physical gratification. After the banquet is over to-morrow, I shall take the opportunity of moving in this Convention that the annual banquet be dispensed with, and the funds be devoted to some more profitable purpose.

The President put the motion to adopt the Secretary's report. Carried.

The President read a telegram from Mr. McLea Wallbank, regretting his inability to attend the annual convention and wishing it all success.

The President: In accordance with the constitution and usual custom, in connection with the report of the Secretary-Treasurer, I will appoint Mr. Purcell, of Walkerville, and Mr. Sangster, of Sherbrooke, as auditors to audit the accounts of the Secretary-Treasurer and report to-morrow.

The President: The next order is the reading and discussion of papers, and I will call on Mr. O. Higman, of Ottawa, to read his paper entitled "Dominion Electrical Standards."

Mr. Higman read the paper, which was received with applause.

(See page 132).

The President: You have heard Mr. Higman's very interesting paper on the standards which have been provided by the Dominion Government. I think it is a matter for congratulation that we have some official standards established in this country. This is a matter that perhaps you have not appreciated as much as the companies doing business in Ottawa, who have been in a position to refer to those standards whenever they had any doubt as to the accuracy of their own instruments; and in order to extend these benefits to the whole of the C.E.A. as far as possible, during the past year the Executive Committee passed a resolution and communicated it to the Department of Inland Revenue, asking them to continue their work in this direction and to establish a standardization bureau where electrical companies could get their instruments standardized. It may be a little early to ask for this, but I think if the Association continues to exert its influence in that direction the time will come within a very few years, when a proper standardization bureau will be established at Ottawa, which will be of very great benefit to electrical engineers and others connected with the electrical industries in this country. The paper is before you for discussion. I think this is a very proper occasion upon which to take up the question, if you so desire, of the desirability of a standardization bureau, and it would be well to hear from the members present upon that point. If there was a general desire in that direction some resolution might be passed and transmitted to the Government. In connection with this I might say the Minister of Inland Revenue has extended an invitation to members of this Association to go to the Department and examine the standards which they have provided there. May I hear from Mr. Leonard on this subject, to start the discussion?

Mr. F. H. Leonard, Jr.: The question of a resolution as suggested by the President I think is a very good one. There is no doubt but what the Association needs some headquarters in which they can repair their instruments, and aside from the difficulty of getting a delicate instrument to and from Ottawa for calibration and returning it to the station, it ought to be a great help in the determination of accurate measurements. I feel that the Association ought to at least pass a resolution encouraging the extension of this Department of the Government so as to make it available to all the lighting and power companies in the country, and I will suggest now that a resolution be forwarded to the Department asking that the work be furthered to such an extent as to enable the lighting and power companies of the country to have this department available, and that a certain moderate fee be fixed, which will enable the companies to compare their instruments without being obliged to send them out of the country. Any person that has had occasion to ship out instruments for repairs will realize how difficult it is to get those instruments out of the country, standardized, back again, and then perhaps as soon as they are returned you find that they are inaccurate, or off zero, due to the jostling they get from the express company's hands. If the Secretary will put that motion in order it can be read and I presume there will be a ready seconder.

Mr. O. Higman: It was not intended originally to be a standardizing bureau; the work was introduced as a part of the weights and measures system of the country for testing the apparatus which measures the supply to the consumer. In order to do that we had to get standards, and so we were compelled to get in some standards at once for the purpose of comparison; but I may say we have always encouraged electric lighting companies to send in their instruments to be compared, and a certificate has been given showing the result of the comparison. No charge has been made to companies paying the annual registration fee. I consider myself that the companies paying this fee are entitled to consideration of that kind. Now whether we should proceed, as the President has pointed out, in establishing a regular standardizing bureau is a question that will largely be with the electrical industries of the country. The Government will not move, I imagine, any faster than they are obliged to. It is like drawing teeth to get money for scientific instruments. They do not quite see the utility of them; they think the money would do more good for missionary purposes, and so we have to get along as best we may with the little doles we get from time to time.

Mr. J. J. Wright: I was just about to ask whether this Standardizing Bureau would be simply for the purpose of comparing instruments that would be sent and a report made thereon, or would it be the intention of the Association to ask the Government to establish a bureau wherein these instruments could be put right—calibrated, in other words?

Mr. Higman: That would involve a good deal.

Mr. Wright: If that were done it would manifestly be a great convenience. It is not much satisfaction sending up an instrument and being told it is 4.7896 out. If there was some bureau established by authority where not only standard instruments but switch board instruments could be forwarded and corrected, I think it would be a good thing.

Mr. Higman: I think that should be the direction of the resolution. I have asked the Minister for a trained mechanic, for one thing, out of one of the instrument making establishments, and also for an assistant in the work, and the answer that I got from him was that "he would see." That may mean that we will get it or it may mean we will not get it. But he said at the next session of parliament it was likely he would make it an

independent branch of the public service with some additional help.

The President: There are several things it would be useful to know in dealing with this question. In the first place, the American Institute of Electrical Engineers has moved in the same direction in regard to the United States as it is suggested we should move here in regard to Canada. They asked the American Government to provide a Standardization Bureau. Perhaps somebody here will be able to tell us just what that means; whether it is intended to have a bureau for the mere comparison of instruments or whether it is intended this bureau should undertake the correction of instruments? I presume the standardization bureau that was asked for in the United States was to be on the same lines as similar institutions in other countries and if it is customary in such bureaus in European countries, where they have been established, to correct instruments as well as compare them, then I presume the Institute's request included the same feature and that we should embody the same thing in our resolution. Another thing we should know is what means we have got in Canada for comparing instruments. Some of the members here who live in Montreal may enlighten us in that regard. What facilities are there at McGill University for that kind of work? Will they make a comparison? I don't suppose they make any corrections, but will they make comparisons? I think these things would help us in arriving at a conclusion as to what action we should take.

Mr. G. R. Duncan: In McGill University they have a very complete set of calibrating instruments. The general custom is to take an instrument and compare it and draw out a curve showing at a glance what the correct reading should be for any indicated reading on the instrument. The average instrument, such as the voltmeter, may not be so much out near zero as it may be farther on the scale. The error of the reading may possibly be due to irregularity in the magnetic field. Such a thing as that would be difficult to repair. In fact, I don't know of any method for repairing that. The only thing to do is to calibrate the instrument, showing, by means of a curve, what should be the reading for any indicated reading of the instrument. I think McGill University will calibrate any instrument and give it a curve such as I have described. As for repairing instruments, I believe they do, on special occasions, repair an instrument, but I don't think they make a business of it regularly. They have there instruments for measuring with an accuracy of something like one part in ten thousand for measuring current or resistance or E.M.F.; and I think one of our men has got comparisons of one part in 100,000. As far as comparing and calibrating instruments is concerned, I don't think there is anything to excel the equipment of McGill University.

Mr. Higman: With reference to the United States, at the last Session of Congress they passed a bill voting $250,000 for the building itself, and providing for a staff, the salaries aggregating $27,000 a year, comprising a director of the bureau and three physicists, three chemists and some mechanical assistants. I presume the intention is to calibrate and repair instruments sent to them.

The President: Mr. Leonard, what form do you wish to give your resolution? Do you want to include the repairing features?

Mr. Leonard: I think it would be well to do that, to make it cover the calibration as well as comparison. If we could get a standardization which bears the stamp of the Government it would be well to get a chart or something which would enable us to read our instruments correctly. I think we ought to go still further, to suggest the extension of the department to cover the repairing or adjustment of instruments.

The President: It is moved by Mr. Leonard that a petition be addressed from this Association to the Government, stating to them that it is the desire of this Association that a standardization bureau be established by the Government wherein instruments may be compared and calibrated and repaired, which are used for making electrical measurements.

Mr. Thornton: Is it absolutely necessary to have an instrument repaired? If you have got a calibration curve I think that is about all that you want.

The President: If you are asking for anything from the Government it is a good scheme to ask for more than you want.

Mr. Holman: You are asking a great deal of your Government to ask them to institute a department which will be an adjunct of your calibrating department in which department you will have repairs made. All makers of instruments like instruments for repairs sent in to them, and to ask your Government to go into the repairing business is something they won't do, it seems to me. Any physical department of any institution will naturally furnish a curve upon being asked, and that curve will be sufficient for the reading of your instruments and make them accurate. If the instrument is actually out of order and needs repairing the proper place to send it is to the maker.

The President: The point made by Mr. Leonard was the difficulty of getting the instrument to be repaired, across the border. You have got to get a lot of papers filled out and there is the shipment of the instrument. There is a great deal of delay. In every other sense it is undoubtedly better to send to the makers.

Mr. Martin: I second Mr. Leonard's motion.

Mr. J. J. Wright: Before that motion is carried and before the question terminates it should be thought over a little more carefully. Of course I asked a question as to whether this bureau would undertake to put an instrument right when it was wrong as well as to tell you how much it was wrong, but I did not quite endorse that view of it. There is a good deal of force in what the last speaker said. We must be careful in approaching the Government, in asking for anything, that we go about it in the right way and ask for exactly what we want. I think your theory on general principles is a pretty good one: ask for plenty and then perhaps you will get something you are looking for. But in this case it bears rather a different interpretation. I am inclined to think that the principal function the Government should be called upon to undertake would be purely the calibrating of the instrument; it would then become a standard for the company. The calibrating curve could be used with that instrument when it was used as a standard instrument only. The company which employs good mechanics can then repair and have repaired their station instruments, using the calibrated instrument as a standard. I think the question ought to be a little more thoroughly considered as to whether that would not be about the extent of the function which we could ask the Government to undertake.

Mr. Reesor: I think Mr. Leonard's difficulty could be got over in this way, to request the Government to ask the makers of these instruments to come over on this side of the line. (Laughter.)

Mr. Thornton: What is wanted, it seems to me, is not a very high degree of accuracy for all instruments used in the station. Most companies have a large number of instruments that are in daily use and also a set of standard instruments, which they use to standardize all the other instruments from. As these station standards are liable in time to get out of calibration, it would be a great advantage to be able to send them to Ottawa and have them re calibrated rather than to have to ship them out of the country.

The President: It has been suggested to me that it might be a good way to deal with this question to appoint a committee of this Association to carefully consider the whole question and then draw up a memorial to the Government in proper form, asking for such advantages as are deemed proper. Perhaps it could be done better in that way than by passing a resolution hastily without proper consideration. However, that is a mere suggestion, and the only resolution before the chair is that of Mr. Leonard. If there are any amendments I would like to hear them.

Mr. Leonard: I would be quite willing to withdraw my motion and leave this matter open for a committee. I think it would be put in better form probably if we had a little discussion on the matter and arranged upon a resolution which we could present to the meeting, which would cover exactly what we want, rather than to do this thing too hastily.

The President: It will be necessary for some one to move that a committee be appointed.

Mr. Martin moved, seconded by Mr. Kitchen, that the President appoint a committee to draw up a properly worded memorial to be presented to the Government, the personnel of the Committee to be left to the President of the Association to appoint. Carried.

The President: I will appoint on this Committee Mr. F. H. Leonard, Jr., of Montreal, Mr. P. G. Gossler, Montreal, Mr. J. W. Campbell, Toronto, and Prof. Owens, of McGill University.

Mr. O. Higman: There was one subject in connection with the Government work I would like to allude to and that is with regard to the Inspection Act. We secured an amendment last session whereby inspection by the Government is made absolute and the inspection of meters by what we call tramp inspectors is prohibited. Those people in fact went so far as to create a company called "The Standard Electric and Gas Meter Company"; they undertook to give certificates and make inspections and it was found necessary in order to protect not only the supply companies but the consumers themselves, to pass an amendment whereby any inspection apart from the Government inspection was made illegal, with a penalty of $25 for each inspection.

At 4.15 o'clock p.m. the Convention adjourned to Thursday, at 10 o'clock a.m.

## SECOND DAY.

The President in the Chair, called the Convention to order at 10.15 o'clock.

A telegram was read from Mr. Edward Slade, of Quebec, stating that by reason of unexpected and important business he would be prevented from attending the Convention. An invitation was also read from Mr. Evans of the Montmorency Light, Heat and Power Co., to hold the next Convention in the City of Quebec.

The President stated that Mr. Doherty had sent word to Mr. Gossler, Chairman of the Committee on Papers, that he had been taken ill and would not be able to travel, and he much regretted he would not be able to attend the Convention and read his paper.

Mr. J. M. Robertson, of Montreal, read his paper on "The Influence of the Load Factor on the Design and Operation of a Lighting and Power System," which was well received. (See page 136).

The President: Gentlemen, the paper just read by Mr. Robertson is certainly one of the most exhaustive and practical we have had before us. It is now before you for discussion and I trust the discussion will be such as to bring out all the very important points it covers in order that it may be useful to us in a greater degree.

Mr. J. J. Wright: I do not feel myself competent to discuss a paper of this nature, but for the sake of starting somebody else going I just call your attention to one part of it that strikes me as being worthy of notice, and that is the meters spoken of by Mr. Robertson with a varying speed, which would be very desirable to measure power, but under the circumstances I think it would be impracticable here with the Dominion laws governing the inspection of meters. Perhaps Mr. Higman can enlighten us on that.

The President: I would like to know from Mr. Robertson whether these meters, which I understand are self-winding, clock-working, are reliable and can be depended upon to change at the proper time so that the total reading would be correct.

Mr. Robertson: That is exactly the trouble with the meters that are on the market now; they are not, so far as I know, entirely satisfactory in that way. A great many of the self-winding mechanisms are actuated by batteries and these give trouble at times. In America there are not a sufficient number either made or installed to tell a great deal about them. With reference to Mr. Wright's objection that they would not comply with the Inland Revenue regulations, I personally would not want a meter that would run fast or slow, I would want a meter that would run on two dials; and it would simply be a question of making a different rate for the indication of one dial to that on the other; the entire registration of the day would be the sum total of the two dials. That would comply in every way with the Government regulations, as the meter itself could be entirely sealed the same as an ordinary meter and the governing medium would be outside of the meter. There has been something designed by which they control the overlapping of the dials on the circuit, but as most of the lighting in Canada is alternating it is not applicable. I think it still remains for some very enterprising companies to get out a meter that is really good.

The President read the report of the Committee on the nomination of the Standing Committee as follows:

Committee on Statistics: Messrs. A. A. Wright (chairman), K. B. Thornton, and J. F. H. Wyse.

Committee to Confer with Underwriters: Messrs. P. G. Gossler (chairman), Edward Slade, A. A. Dion, Alderman Sadler, A. Sangster and J. J. Wright.

Committee on Arc Light Rating: Messrs. O. Higman

(chairman), P. G. Gossler, Fred Thomson, John Yule, Prof. Owens, J. R. Robertson, and A. B. Lambe, Jr.

Committee on Legislation: Messrs. John Yule (chairman), B. F. Reesor, A. A Wright, C. B. Hunt, W. H. Browne, A. A. Dion, W. H. Briethaupt, R. O. McCullough, J. J. Wright, with power to add to their numbers

Committee on Standardization of Accounts: Messrs. D. R. Street (chairman), H. H. Henshaw, A. A. Wright.

Mr. J. J. Wright moved, seconded by Mr. A B. Smith that the report be adopted.

Mr. Yule: Before that is adopted, I suggest that Mr B. F. Reesor be put on as chairman of the Legislation Committee. He has been on for a great number of years and his services have proved very efficient and valuable in that position.

Mr. Reesor: I think Mr. J. J. Wright makes a very good chairman; and he is all right and in the right place.

The President: Mr. John Yule is named as chairman here.

Mr. Reesor: He is a better man, perhaps. (Laughter.)

The President: We have all come to regard Mr. Yule as being so fond of this work that we do not like to take it from him.

The motion to adopt the report was put and carried.

Mr. L. Denis, of Quebec City, read his paper on "Balancing a 3-wire Alternating Secondary System," which was greeted with applause. (See page 134).

The President: This is another valuable paper which I hope you will not let pass without some comment. It would be really too bad that the paper read by Mr. Robertson and also this one should not provoke some discussion. They surely give room for discussion.

Mr. Fisk: Mr. Denis mentions in his paper properly fused junction boxes in the two outside secondary wires I would like to have a description of that box and the kind of fuse.

Mr. Denis: The box used is an ordinary cut-out motor fuse box—an ordinary street car motor fuse box; and practice shows that the fuse to be used should not be above a third of the capacity of the transformers that are banked. Sometimes we have to exceed that though, that is, when we cannot get the proper line arrangements.

Mr. Leonard: Did I understand that the fuse was to be one-third or one and one-third?

Mr. Denis: One-third. It is only supposed to be used when one transformer is loaded more than another. I may add that we have to inspect these junction boxes every week. We are very particular about that. And of course we replace any fuse that is blown; also whenever we have any blown fuse, a special study of the district and the condition of the load has to be made, because the fuse should not blow.

Mr. Thornton: We have one or two secondary three-wire systems in Montreal, and that matter of blown fuses is quite a thing. We do not make a point of making a special inspection. Our attention has generally been drawn to the fact that there is a fuse blown somewhere by a telephone message from a customer that the lamps are rather dim. We only have one or two of those systems and we have not made a specialty of special inspection. There are one or two points in Mr. Denis' paper I would like to refer to. With regard to the slips that are given out to the foremen, I did not quite understand how they designated which side of the three wire system they wanted the customer to be connected from. I always, in Montreal, designate them by saying I want them connected from the sidewalk side or the street side. We have maps showing the sections, the size and everything else of the wire, and you can very easily lay out for yourself what side you want the customer to go on, and you simply tell the line foreman that you want the customer of such and such an address to be connected from the street side or the sidewalk side. We also find, to be absolutely certain of our records, we have very often to make a second inspection of the line to make sure the lineman properly reports the work he has to do. He turns in his slips in the same way as Mr. Denis reports on, but we find they are often inaccurate.

Mr B. F. Reesor: I would like to ask a question. What kind of fuse does Mr. Denis use—an alloy or just common fuse?

Mr. Denis: Just common fuse.

Mr. Reesor: When you said one-third of the capacity did you mean of the bank or the transformer?

Mr. Denis: Of each transformer. The transformers that are banked are all of the same capacity. The fuses in the junction boxes all along the bank are a third of the capacity of each transformer.

Mr. Reesor: The way we do in our case, in designating the different lines, is this, instead of using cross-arms we have the wires on an iron bracket under the cross-arm and they go in a triangle and we designate them by the top or bottom wire.

Mr Robertson: I understand from this with regard to the connection of the transformer to its own mains, that the mains run each way from the transformer?

Mr. Denis: Yes.

Mr. Robertson: When you have to reinforce a transformer how do you know on which side of that overloaded transformer to connect the other one?

Mr Denis: In that case a special study of the district has to be made. The bank is not only subdivided into transformers, but the transformer has to be subdivided on each side and trial records made of that.

Mr. Robertson: That is what I wanted to know. You said you did it on your records and I wondered how you did it in the office.

Mr. Denis: Oh no. The only information regarding it which the records give is that a certain portion of the bank, say one transformer is being overloaded. If you want to go into further details you have to subdivide that portion of the bank.

Mr. Robertson: Also, when you say what its approximate maximum demand will be, how do you know it is going to arrive at the same ratio?

Mr. Denis: It didn't at first, but the figures show they all bear the same ratio.

Mr. Reesor: What means have you of ascertaining when a fuse in one transformer goes? Just by the lights themselves?

Mr. Denis: In a transformer or junction box?

Mr Reesor: In the transformer.

Mr. Denis: Then the junction box fuses would go too.

Mr. Reesor: If it is not overloaded?

Mr. Denis: In most cases it is. If it is not and if we found by our records we could dispense with that transformer, we would, immediately.

Mr. Reesor: Your minimum load might be on and it would not be noticed until the maximum load came on and then the whole thing would go.

Mr. Holman: I have used the Wright maximum demand meter on a transformer to ascertain its maximum load; I have also used it for the purpose of ascertaining the load of a customer when I was suspicious that that customer was using more than a normal amount. We put the meter out on a pole.

Mr. Denis: We corresponded with the Wright Maximum Demand Meter Company and never got any answer. We asked them if their meter would stand to be put out on a pole and we never got any answer from them.

Mr. Purcell: I have used the same instrument for that purpose and put it on any voltage and it is one of the finest instruments you can get hold of; and it is surprising how the results will differ from what you think they are.

Mr. Denis: It doesn't seem so from these figures. We find now we can almost dispense with them, although we didn't at first.

Mr. Holman: It was only on a suspected circuit that the instrument was used; we did not have one meter for each of our transformers. We simply used them for confirming or exploiting our ideas in connection with that transformer; and as the gentleman immediately after me stated, I have found the facts as represented by that meter a little at variance with my ideas of what the transformer was.

Mr. J. J. Wright: I think we should not let the occasion pass without moving a vote of thanks to both Mr. Robertson and Mr. Denis for the two able papers we have just heard read.

Mr. Martin: I take pleasure in seconding the motion.

The President put the motion, which was carried with applause.

Mr. Holman: Before adjourning for the morning I have one question to ask Mr. Robertson. His paper is worthy I think of a great deal of thought and there is one very small question that occurred to me. I would like to know his experience with the use of a meter for measuring small capacity motors, where the load on that motor was of a thoroughly variable nature, whether the customer complained of his bills or not?

Mr. Robertson: I am afraid Mr. Holman has asked a good deal larger question than he thinks. We have a very large number of small customers, varying from one half H.P. up to anything you like and we do have a considerable number of complaints from our smallest customers with reference to bills, but as a rule it is because some outside person speaks to the customer and tells him something about his meter, and he then proceeds to read his own meter and figure out his bill. We find as a rule when we take the question up with him we have no trouble at all. We are using a Stanley meter for small customers and have no trouble whatever in proving to the customer that the meter is correct; should he so desire we offer him the option of having it tested himself and he may call in any outside person he likes, we having the right to be present. I might say with reference to accuracy of integrating meters on variable load that they are as perfect as there is any necessity for. The inertia of the moving element is so little that with full load on a meter the time elapsing between opening the switch and looking at the meter is sufficient for it to stop. Some time ago there were some elaborate tests made on Thompson wattmeters to determine the error introduced by inertia and the instruments were found to be practically accurate. As the inertia of such a meter as the Stanley is much less, the accuracy would be correspondingly greater.

Mr. B. F. Reesor moved, seconded by Mr. John Yule, and resolved, that the sympathy of the members of this Association now in session at Ottawa be, and the same are hereby extended to our esteemed fellow member, Mr. A. A. Wright, M.P., and family, of Renfrew, in his bereavement by the death of his only daughter; and that a copy of this resolution be forwarded by the Secretary to Mr. Wright.

The President: You have all heard the resolution. It is especially regrettable because Mr. Wright has been a constant attendant at our Conventions. I do not remember one where he was not present and did not take an active part, and when I missed him here on the first day I supposed there must have been some very serious reason to keep him away.

The motion was put and carried.

GENERAL BUSINESS.

Mr. Thornton: In regard to the institution of a student membership clause in connection with the Canadian Electrical Association as suggested in the Secretary's report, the Canadian Society of Civil Engineers have a student's membership, and I think it would not be a bad idea to have the same introduced in connection with this Association, with a view to infusing new blood into the Association from time to time and also drawing members from the scientific and technical colleges throughout the country, and I think we may get some good men out of them. I think it would be very useful to the Association.

The President: I think the Secretary has given this question some attention, and if I am not mistaken he has consulted with some of the authorities of some of the colleges in that connection and I would like to hear from him.

Mr. C. H. Mortimer: I may say Mr. President and Gentlemen, that I have not consulted with the authorities of the schools with regard to this matter, but it has occurred to me, and I have thought for some time past that this Association might and ought to keep itself in touch with the young men who are passing through our scientific schools; and a short time ago I noticed that the Canadian Mining Institute had established a special fee for students of one dollar per year, and it occurred to me it might be a good idea for this Association to have a special fee for students that are passing through, taking the electrical course in our scientific schools; and these students would, after passing through the schools, probably become and remain members of this Association, and would become valuable members.

Mr. Reesor: They would be associate members in the ordinary way?

Mr. Mortimer: Yes. I would suppose that they would become associate members. I don't suppose they would desire the right to vote. And I thought also that perhaps the Association might offer a yearly prize to the third year students in the electrical department of our scientific schools, which would also keep the Association before the students in the schools. I would be very glad if the membership would express their opinions upon the suggestions.

Mr. Purcell: I think it possibly would resolve itself into a matter of funds. I thing if necessary to give a prize it might be desirable to advance the fee for active

membership, say from $3 to $5. I for one do not feel at all backward in coming up to the additional amount, and I feel heartily in accord with the movement suggested by our Secretary.

Mr. E. B. Biggar: I may say that in attending the annual meetings of the Canadian Society of Civil Engineers I have noticed that the student members of that Association avail themselves very fully of the privilege of attending the meetings, and at many of these meetings the attendance of the students at McGill is larger than that of the regular members. They have three or four classes of membership, a full membership, an associate membership and student membership, the student membership being for the students of colleges and universities. I think Mr. Mortimer's idea is a very excellent one; I feel sure that the Association will find a very great benefit in the immediate future.

Mr. Mortimer: I might say this prize, in my opinion, need not be a very large prize, and it might be given for a paper or thesis which could be read at the annual conventions.

Mr. McBurney: In the way of a suggestion, I would say that the same thing seems to strike nearly every member I have spoken to, that if a fee of $2 were charged for the annual dinner, not touching the funds of the Association, it would be satisfactory to every one. I would not like to say anything about the management of the Association, any more than to make a suggestion, and that would be this, that if a clause similar to what Mr. Mortimer has spoken of were introduced into the organization I think it would exclude or have a tendency to exclude some of the plant managers; I think the tendency would be for some of them to stay at home and let the students, who are not so much interested in the Association, attend the Conventions.

Mr. J. J. Wright: I think if there is any such suggestion adopted it would be a very favorable opportunity to revert to the original intention of Constitution and to draw the line more sharply between active and associate members, which has gradually become obliterated. The fee is different, but the standing appears to be about the same. If three grades, as in the Canadian Society of Civil Engineers, were adopted it would be in harmony with the constitution and there would be the active members, with all the name implies, the associate members and student members. I do not exactly agree with the idea of the last speaker that the admission of students would necessitate or cause the control of the Association to pass entirely, or in any other manner, into their hands, because the powers of the various grades in the Association would be necessarily defined and limited.

The President: This is an informal discussion, there is no resolution before the chair, therefore I may be privileged to speak upon it. My own views are that we ought to have three classes of membership in this association, three well defined classes, active, associate and student members; and that the fees ought to be $5 for active members, $3 for associate members and one dollar for students. That is the way I would like to grade it. Now, as to the question of having a prize for an essay or paper to be read at the annual convention, I think it is a very good idea, but I think the Executive Committee already have sufficient powers to enable them to carry that out if they deem it desirable, after the student class membership has been instituted. They could offer such a prize and get papers to be read at the annual meeting, and this prize need cost very little, because it is not the intrinsic value of a prize of that kind which gives it worth; a medal at a comparatively small expense would be entirely acceptable for a thing of this kind. I don't know just how these changes could be carried out; I think it would be necessary to amend the constitution, and I don't believe that according to the existing constitution we could do anything at this Convention. If I remember right it is necessary to go through a certain form of notice, and it is quite doubtful if we could carry it out so as to make any changes in the constitution at this present convention; but I think it is well to discuss the matter, and if we can get our views narrowed down to certain lines and embody them in the form of a resolution we could appoint a committee to develop the scheme and prepare amendments to the constitution. I may say that during the past year the Executive Committee has been engaged in revising the constitution to some extent; it seems to be defective in some respects, and this work was not completed, so that the whole thing could now be taken up together and at our next meeting a proper scheme could be proposed ready for adoption. If your desire is that student membership be established at once, and if the constitution affords a way to do it at this meeting, I would be glad to do all I could to assist.

Mr. A. B. Smith: I think on reading the constitution you will find the membership is confined to two classes, associate and active, and we cannot legally make any change unless we amend the constitution. We can at the present make no change, but we can give notice of motion.

Mr. Purcell: I think this matter can safely be left in the hands of the Executive Committee with power to act. They have the power, I think, according to the constitution, to make any amendments.

The President: Not to make amendments.

Mr. Purcell: If not, then some of us can give notice of motion and bring it up at the next meeting.

The President: The constitution provides for two classes of members, and of course if we add another class we amend the constitution. I will read you the clause regarding notice of amendments to the constitution. (Reads Article X of the constitution). If I interpret this rightly you should get permission this morning to introduce an amendment and give notice thereof. This could be considered at this afternoon's sitting, the chairman could then appoint a committee to whom it would be referred, and this committee could report to-morrow morning, and we could then dispose of the matter, when it would require a two-thirds vote of the members present to carry the amendment. I do not suppose, in giving notice of motion, it is necessary that the exact wording of the amendment be stated, because it may require some little time to get at the proper wording, but if notice of motion was given that Article 3 of the constitution be amended by creating a student membership class, I think that would be sufficient, and the matter could be dealt with in that way; but it would be necessary to have the permission of two-thirds of the members present to put on record a notice of motion at this morning's sitting.

Mr. A. B. Smith: I would suggest that the sense of this meeting be taken as to the admission of student members, and then if it be favorable that the revision of

the constitution which is necessary be undertaken by a committee to report later.

Mr. Purcell: I will ask permission to introduce a proposed amendment.

The President: The question is, shall we permit Mr. Purcell to give notice of motion that Article 3 of the constitution be amended by creating a class for student membership and fixing the fee?

A vote being taken on the proposition it was declared carried unanimously.

Mr. Leonard: I would like to ask a few pertinent questions on the matter of student membership. What is the Association to gain by this special membership, if we ask, as proposed, a fee of one dollar? The cost of a seat at the banquet will more than amount to that. The funds of the Association are not going to be benefitted. I believe that such a membership would be a benefit perhaps to the Association and also to the student members whom we might succeed in gathering in. It places a young man in contact with men of experience in a line of business which he proposes to follow in his future life, and enables him to pick up pointers whereby the college will help him in the future. So far as a thesis or paper that might be prepared by a college student is concerned, the Association I think would have comparatively little to gain in the practical operation of the business. It would probably be of a theoretical character and something which many of the practical men would not be able very well to follow. However, as I said I only wanted to ask a few pertinent questions and get the members thinking about this thing to see what it amounts to.

The President: I might say in reply to Mr. Leonard I did not state all my views regarding this question of fees. I stated I thought active members should pay $5; in the first place, that is an increase of $2 over the present fee. I am also of the opinion that the Association should not be expected to provide a free banquet for its members. There is no other Association possibly in the world that does it. I have never attended a banquet of the kind without having to buy a ticket, unless I was a specially invited guest. I am not in favor of dispensing with the banquet, but I am in favor of making it a pay banquet. There are members who do not care for banquets and we should not compel them to attend; but those who like banquets should assemble together and pay their fee just the same as they would anywhere else. This will properly come up in a resolution which I understand will be presented to-morrow, and perhaps as presiding officer I should not have stated my views on this subject. However, I say this to show that the introduction of the student membership would not involve any expenditure to the Association.

Mr. Moore: The Canadian Society of Civil Engineers has a very large student membership, and every year they transfer a very large percentage of the student members into associates and active membership. As regards a thesis, some students are very theoretical and some students are very practical. I feel quite sure there are a great many students who will be able to give a paper that would be of interest and also have a practical benefit. The student in the laboratory has at his service some of the very best equipments for testing apparatus that is used every day. I have seen transformers and other apparatus sent in to the university to be tested which could not be tested at any other place; and a paper has been presented describing the process of testing these apparatus which has been of very great practical benefit to those who bring them to be tested. Very often a student that is taking an engineering course can write a very good paper. I think in my opinion the President has very good views with regard to the dinner; I don't think a student would ask for a free dinner. In the Engineers' Society the student has no vote; attending the meetings and coming in contact with other engineers is where the student looks for his benefits.

Mr. Hamilton: The American Society of Mechanical Engineers has a student membership, and at nearly every Convention there are one or more papers presented, written either entirely by these student members or by a student member in collaboration with older men, and these papers are regularly published in the annals of the Society and form part of a very valuable collection, because as a rule they are papers on tests made by having at their disposal the finest equipment to be found anywhere, and these tests are worked up more fully because a man has more time; and they form a very valuable part of the literature of the Society.

The President read the report of the Auditors, stating that they had examined the books and vouchers of the Secretary-Treasurer and found everything correct.

At 12.10 o'clock the Convention adjourned to 2.15 o'clock p.m.

AFTERNOON SESSION.

The President called the convention to order

The President: The first order of business for this afternoon is a notice of motion which was recorded this morning regarding the amendment of Article "3" of the Constitution. This is now open for discussion. If Mr. Purcell is here he could tell us what particular form he wishes the amendment to take.

Mr. Purcell: The object in bringing this motion before the Association is to make it possible for young men, students—not to make it necessarily a student membership, but to make it a membership whereby young men who are students in scientific branches or following up or possibly taking a course by correspondence might become members of this Association, because in the future they are to be our station men and possibly managers. I gave the notice of motion for the purpose of having the matter thoroughly threshed out before getting it into shape, and before wording it at all

Mr. J. J. Wright: That would bring up the whole question of varying grades of membership, active, associate and student membership. If it is proposed to amend the constitution it would be well to take up these questions together and also the question of fees to be paid by each of these classes so that the whole thing could be incorporated in the constitution at the one time

Mr Hamilton: It seems to me a large part of the value to be derived from this junior membership would be the fact that these men were associated with technical schools whose facilities were such as to make the work of the students of some value to the Association. It does not seem to me it would be wise, therefore, for the Association to open the doors to any young man interested in electricity; I should think it would be rather better for the Association to say that membership or a certain number of years study in a technical school, the

number to be decided upon by the Executive Committee, should be eligible to junior membership.

The President: Gentlemen, the question as I understand it is a pretty broad one. Article 3 of our Constitution defines two classes of membership, active and associate. The distinction is not very clear and I think the wording of that article could be improved upon so as to better draw a line between the two classes. As it now stands, the distinction is so slight that gradually the line has been obliterated, as was stated this morning, so that now it remains altogether with the applicant to state whether he desires to be an active or associate member, and the Executive Committee have no choice, practically, but to admit him to the class to which he asks to be admitted. There has been a desire expressed in some quarters that there should be two defined classes, active and associate members, and then it was suggested later that we should have a third class of student members whereby students in colleges, technical schools and universities might join the Association by paying a smaller fee than the ordinary members; and that these members might be allowed to submit a paper at each annual convention. For instance, a competition might be got up that the student who produced the best paper in the estimation of the committee appointed to judge would be allowed to read his paper before the annual convention. That is the question before you now as I understand it, and as Mr. Purcell I believe wished to raise it. Although Mr. Purcell applied himself particularly to the creating of a new class of membership, I think it would be well since the question has been brought up, to get a very full expression of opinion from the meeting as to what is the desire regarding this membership question, so that when the constitution is taken up and this clause is re-written it should be done thoroughly, it would not be necessary to take it up again next year. In order that any amendment may be carried it is necessary that the matter be settled this afternoon, and according to the constitution a committee will be appointed to draft a clause and to-morrow morning the amendment to the constitution may be made, provided two-thirds of the members present are favorable to the change. What I ask you for is an expression of your opinion regarding membership generally, whether the present article is right or whether we should amend it and in what way. I think you should not restrict yourself to the student membership but discuss the whole question. I invite you to freely express your opinions so that we may know what the feeling is.

Mr. F. Nicholls: The present constitution covers all the ground that is necessary, and I think if trouble has arisen, if trouble it can be called, it is because this rule has been more honored in the breach than in the observance. I have always felt strongly that the executive officers of the Association should be composed wholly of members that are actively engaged in operating companies, and I have felt that it was a serious mistake, that it was a menace to the future well-being of the Association, to have the offices open to those representing manufacturers and supply and other commercial companies whose commercial interests are to sell supplies to the active members of the Association. I have been consistent in this. I was present, Mr. Wright will remember, and Mr. A. B. Smith and others, at the very first meeting, when it was proposed to organize the C.E.A., when that question came up, and at that meeting I was honored by being asked to allow my name to go in nomination for the vice-presidency; I declined then because I felt then, and I stated then, that my conviction was that being interested in a manufacturing company I was not eligible, and that I would not, at all events, be the one to set what I considered such a bad example. We had that experience years ago with the National Electric Light Association, of which I was then and am now a member; we had quite a discussion and it finally resolved itself into drawing the line hard and fast between the associate and active members. We do not have enough interest shown in this Association by the active members; we do not have a sufficient proportion of the central station managers attend our convention. In looking over the list from year to year it strikes me that the proportion is about two-thirds to one; in other words, two-thirds what we may call the commercial end and one-third the operating end. I think it would not be a very difficult matter to change that proportion. Not that you would have less of the commercial end, because their business interests, if nothing else, will cause them to be present at these meetings which bring so many of their friends and customers together, but I think while there would be no less number of commercial representatives present, that there would be a very large increase in the central station representatives if it were felt that the Association were going to take up matters and work more diligently in the interests of matters that so directly affect to-day the operation of central stations, and more particularly the value of their capital invested. I don't know how it is in Quebec, but in Ontario everybody that has a dollar invested in an enterprise that is largely dependent upon a municipal franchise sits in fear and trembling from the moment the Ontario Legislature meets until we heave a sigh of relief after prorogation. We don't know unless we have someone watching every bill that comes up—there is some little thing, one clause of an unimportant bill that will come up that will be fraught with all kinds of danger to those who have capital invested in electrical enterprises, and this Association through its Legislation Committee has certainly done some grand work during the last two or three years, but I think in the time of peace we have to prepare for war, and we are going to have more trouble in the future than we have had in the past. I am not going to say very much more about it, although I reserve the right to speak again on this question if, in answer to any arguments I may hear, I wish to submit the broad question for discussion whether it is not better in the interests of the Association to draw the line sharply between the active and associate members, as was at first intended when the constitution of this Association was drafted and accepted by the Association.

The President: Until someone desires to speak upon this I might explain the possible reason why the Executive Committees of the past few years have honored this rule by the breach rather than the observance, as Mr. Nicholls says. From the peculiar wording of this clause: "The term active members includes all members actively engaged in electrical business. The term associate includes those interested or actively engaged in any electrical pursuit." I can't see any difference. I gave it up long ago. That is exactly why the line was obliterated. There never was any line in so far as the wording of the constitution is concerned. And if there is to be any line this article must be amended.

Mr. Nicholls: So as to have the matter open for discussion I move that an amendment be made to the constitution which, in effect, will mean that the active membership be confined to those who are altogether engaged in the operation of central stations, whether they may be electric light, power, telegraph or telephone men; that the associate members be those who are engaged in the selling end of the business. That can be worded suitably. That is the sense of the resolution.

Mr. Purcell: My motion is to amend the constitution as seen fit by your committee of five which will be appointed.

Prof. Owens: I second the resolution.

The President: The motion is that the constitution be amended in such a manner as to create a class of student members. I think we might take both Mr. Purcell's and Mr. Nicholl's motions together.

Mr. Nicholls: I am willing to add Mr. Purcell's motion to mine or to allow mine to be added to his.

The President: Mr. Nicholls moves that the article be amended so as to define clearly between active members, who shall be those engaged in the operation of electrical

plants, and associate members, who shall be those engaged in the selling of supplies. I think these motions should remain on the table until we have had some more expression of opinion.

Mr. J. J. Wright: That would exclude from active membership those who are scientifically engaged in electrical matters outside of the actual operation of central stations. We have a number of men now who are professors in various colleges and universities, and if the wording of the clause was made to cover only those actively engaged in the operation of central stations it would have the effect of excluding the others.

Mr. Nicholls: That is not the intention.

The President: What is meant is that there should be a class of people who sell goods and another class of people who do not sell goods.

Mr. Leonard: Just to make it clear, I am not connected with either of these departments, I am in the engineering business, and it seems to me I would be classed out altogether. I would like to enqutre which category I should come under; and Prof. Owens, in the same way, would not be included in the motions as originally framed.

The President: Do you sell goods?

Mr. Leonard: No.

The President: Then you are in the other class.

Mr. Leonard: Which other?

The President: The class which does not sell goods. (Laughter).

Mr. Leonard: The members who do not sell goods are entitled to full active membership.

The President: Provided they are connected with the electrical business in some way. Unless there is any more discussion the matter will go to a committee. This is not to be voted on this afternoon, but the object of this discussion is simply to enlighten the committee who will draft a clause as to the particular way that the clause should read. The discussion and vote will come up to-morrow morning when the committee report after having drafted the amendment as desired by the proposer.

Mr. Smith: How about the question of fees?

The President: The notice of motion only covers article 3, and does not cover article 5. The notice of motion should have been made to cover both articles. I think it would be in accordance with good practice to allow this notice of motion to be altered by unanimous consent of this meeting. There being no objection the notice of motion was altered to include article 5.

Mr. Leonard: Before this committee is appointed, and before we lose sight of this matter of classification of membership, I would like to raise another point, not for immediate decision but for the consideration of the committee appointed. My own case made the next instance occur to me. Take Mr. Kynock; he is in the engineering department of the Canadian General Electric Company, he is not in the sales department, but he is an attachè of the Canadian General Electric Company, and I might mention a couple of other members here I see before me in similar positions. How would it be proposed to classify them? It does not separate the two classes in exactly the way I take it Mr. Nicholls intended it should be divided. As I understand Mr. Nicholls' idea is to make this Association an association of electric light companies or companies in the electrical business, and follow somewhat after the pattern of the American Association known as the National Electric Light Association. It makes rather a complex matter, this division and subdivision and classification, it seems to me; and I think there is a chance for a little further discussion before the committee attempts to act.

Mr. Nicholls: The committee are not going to act, they are simply going to recommend. We will have the fullest opportunity for discussion when this matter is brought forward to-morrow.

The President: Yes.

Mr. Leonard: The only reason I had for bringing the matter up now was, we would want to have this resolution drawn in shape so that it would probably pass without the necessity for having it re-written several times and a lot of discussion which we might or might not have time to go into then.

The President: There may be some difficulty in the case of a member connected with a manufacturing company, where his duties might be partially in the engineering and partly in the selling line. But the National Electric Light Association have had experience and I think possibly we could borrow from the wording of their constitution.

Mr. Nicholls: It does not make any difference in so far as the membership is concerned: every member whether he be active or associate, has every privilege of the association except that of election to office; and what I claim is that this primarily should be an association—I am not trying to change, and I don't care which way the vote goes, but as I am here I am saying what I think; if the others do not think with me I don't feel at all aggrieved over the matter—I understand or did understand it that the object of this Association was to get more particularly central station men and the men whose capital is invested in operative enterprises together for mutual improvement and for protection. I understood that was the motive of it. Whether you have two classes of membership or not, the main motive of my resolution would be to allow only the operative men to be eligible to office. I make that explanation so that as far as my own feeling is concerned, it may not be misunderstood.

Mr. J. J. Wright: However unfortunately the constitution may be worded, as one of the charter members of this Association I distinctly remember at the first meeting that the intention was as stated in the resolution of Mr. Nicholls; and in regard to any fine cut distinctions as to who should or should not be admitted, all these applications for membership have to be passed upon by the executive committee, and I take it it would lie in the judgment of the executive committee to say whether an applicant for membership should come within either one of the three classes, and which one.

The President: Mr. Wright, what would be your opinion as to the effect of such an amendment on the existing membership? There are active members at the present time who would not be eligible under this wording. Of course if the amendment was merely that they were not eligible to office that would not affect it.

Mr. Wright: I think the matter would be somewhat simplified if clause 5 is amended in regard to fees. If the amount of the annual dues is changed it will necessitate a reclassification of the whole of the membership.

The President: I will appoint as a committee to draft a proper form of amendment to submit to the convention to-morrow Messrs. F. Nicholls, J. J. Wright, J. W. Purcell, F. H. Leonard, jr., and R. H. Hamilton.

Mr. Nicholls: I would point out that there are three out of the five members who are on the selling end. I have a good many operating interests as well as manufacturing, but I do not attend this convention as an operating man and I would prefer being left off that committee. I don't think the selling end should come here and attempt to influence the deliberations of the active members. I am perfectly consistent in that and I always have been. You appoint all kinds of committees and on this very committee you appoint three out of five from the selling end.

The President: I took this view. I took Mr. Nicholls and Mr. Hamilton as representing the selling end; I took Mr. Wright and Mr. Purcell as representing the central station men, and I took Mr. Leonard as an engineer connected with neither one end or the other, but standing in the middle, and I supposed that would be a good committee on that account. I tried to make it as neutral as possible.

Mr. Nicholls: Probably I am mistaken. I understood Mr. Leonard was on the selling end.

The President: No, I don't think so. I think if Mr. Nicholls would allow his name to remain, this committee would be satisfactory to this convention.

The President: I have now pleasure in calling upon

Professor R. B. Owens, of McGill University, Montreal, to read his paper on "Transformation from Constant Protential Alternating to Constant Current Alternating."

Prof. Owens read his paper, which was greeted with applause. (See page 29).

The President : You have heard the interesting paper by Prof. Owens, which submits a possible solution of the alternating arc lighting problem. You are all aware of the weak points of the different means used for that purpose, and possibly this will in time offer a solution which will be free from defects. This paper is now before you for discussion.

Mr. Moore : I would like to ask Prof. Owens to give a description of the varied resistances under which these tests were made, whether it was with alternating arcs or with resistances built up in some way.

Prof. Owens : Just a small rheostat inserted with an impedance coil, according to the curve shown in Plate III.

Mr. Moore : The reason I brought up this point is I think it is unfortunate that the investigation was not made with an alternating arc, because the alternating arc has a peculiar property of its own, in that the power factor of an alternating arc is less than unity, without there being a lagging current, this being due to distortion of the wave form and this distorted wave making it very very difficult for a condensor to produce the effect which would ordinarily be expected with the resistances or a varying resistance. I would like to have Prof. Owens' ideas on that point.

Prof. Owens : That would bring up a very interesting point. Any arrangement of this kind with a condensor in series is little affected by the wave form in its operation. In addition to this particular arrangement there are others in which a condensor is in shunt, and such an arrangement is very much affected by change in the wave form. The series arrangement of impedance coil and condensor is I think infinitely better than any shunt arrangement.

Mr. Leonard : Aside from the power factor of the arc, to which Mr. Moore has brought Prof. Owens' attention, there is another practical feature in the operation of series alternating current arcs which those that have had experience with them I think will at least be acquainted with. That is, in order to get a nice feeding circuit of lamps it is a necessity, so far as I have been able to work it out, to have a certain amount of impedance in the circuit, otherwise you get fluctuations, pulsations, or throbs in the light, which destroy the commercial value of the arc, and I don't see that we can do away with that.

Prof. Owens : That is provided for.

Mr. Aldrich : This paper in connection with that by Mr. Robertson this morning has a practical bearing upon the whole question of neutralizing reactance effects in the series type of alternating-current arc light distribution. It has been proven by many experiments with which we are familiar that such neutralization, bringing the power factor of the system practically to unity, enhances the performance of all arc lamps on the given circuit. They are steadier, more reliable and satisfactory than when operated under their usual normal conditions. It is a well-known fact that wave forms influence materially the performance of alternating-current arc lamps. The arc lamp itself will give a most peculiar wave form under certain conditions. Arc lamps can be adjusted for series alternating-current distribution on one generator, at the factory, and it is sometimes almost impossible to get them to work anywhere else till you have gone through another laborious course of adjustments to suit the wave-form conditions of the generator for the service to which the lamps are to be attached. In alternating-current series arc lighting, one is face to face, therefore, with two very difficult, very important and not to say exasperating troubles—one of wave forms and the other of reactance effects and low power factors. Both cannot be killed by one stone, so to speak. But, almost all of these difficulties can be greatly relieved and the whole system brought to a remarkable degree of efficiency and satisfactory performance by the method described by Prof. Owens. A synchronous motor thrown across the line, in parallel (the arc lamps themselves being in series), or even a synchronous generator similarly switched in, will, when operated with a suitably adjusted field excitation, bring the power factor of the whole system practically to unity, giving an unexpected satisfactory performance of series arc lighting service. It has been found by actual experience that such an arrangement of series arc lamps with a synchronous machine is practically equivalent to the method described by Prof. Owens. It will bring the series arc lamps to a remarkable degree of uniformity, regulation and efficiency. In fact, the ideal conditions are thus realized and practical neutralization is effected. The variable load referred to by Mr. Robertson, as being so objectionable in the operation of synchronous motors is here not in evidence. Arc lights are not going on and off every few minutes, as induction motors. When you determine the best operating conditions for given load, with a few minutes' trial, with the rheostat for proper field excitation, you can then set it there over night practically. One or two lights going out will not affect the regulation. The synchronous machine occupies just the relation desired for this work. It has not the inherent disadvantages and limited lagging phase displacement ordinarily found in connection with induction motors. Both of these contributions are on the right track. I think the Association is to be congratulated upon having such practical up-to-date papers as these.

Mr. Layman : I would say this system as described by Prof. Owens comes as near the ideal as anything in practical use to-day, but it is open to one objection and that is that the current is constant. I think the ideal system will be the system in which the current taken from the generator will vary in proportion to the number of lamps in the service.

Prof. Owens : The receiver service is constant ; the current from the generator varies.

Mr. Layman : That is the ideal condition.

Prof. Owens : It is not to be taken that this particular apparatus described here is recently developed. One of the objections to synchronous motors is that they are expensive ; and of course require attendance. It certainly is to be hoped that before long practical and efficient static condensors will be available ; and if they are available to stand high pressure, this system is fairly practicable. We find with the ordinary condensers, you can secure condensers that will stand 500 volts, that means about five lights, and work practically continuously. As to the condenser, you have to make proper provision for ventilation and all that, but there is no reason to suppose that in time we will not have a condensor that will allow a use of several thousand volts, and in the meantime the synchronous motor can be used instead of the condensor up to any size and any voltage.

## TOPICAL DISCUSSION ON THE BEST PRACTICE OF CLEANING, TRIMMING AND INSPECTION OF ENCLOSED ARC LAMPS.

By invitation of the President to open the discussion on this topic, Mr. Sangster said : Mr. Chairman, I don't know that I can say very much on this question. Of course, we have a very small plant, and we have had the lamps in use for but a very short time. However, the few remarks I have to make I have jotted down and I will just read them. I wish to say that this is a subject which I think could have been taken up by men of wider experience in arc lighting, seeing I am connected with a small company with a few lights in the back woods in the Province of Quebec, where the lighting and power business has not advanced so rapidly as in our sister province of Ontario. We have had the series alternating enclosed arc lamps in use for almost two years. I can only give our short experience of trimming, cleaning and inspecting. I may say that we did not have much of the summer weather ahead of us when we installed these lamps, and found the first winter harder on the lamps and more difficult in the trimming than it was the past winter, owing to a few defects in the lamps, which the makers kindly helped us to remedy. These defects were found after the first storm, water getting into the works of the lamps ; we also found the holder for the outside globe froze to the globe and the screw which made it almost impossible to remove. The current had to be put on for an hour sometimes in order to heat the lamps to enable us to get the globes removed. Owing to the frost and water several of our lamps were destroyed and many globes were broken, these defects were remedied and the past winter was much easier in the matter of trimming and fewer breakages. The shortest days in the winter we trim once in five days, and in the longest days of the summer we trim once in ten days, taking one carbon for each lamp when the trimming is done. The carbons required for these lamps you are all familiar with, being one solid and one cored ; they are nine inches long. At the first trimming there is a nine inch carbon put in the upper holder and about six inches in the lower ; at the next trimming the carbon from the upper holder is put in the lower one and the new carbon put in the upper—solid in the upper one and cored in the lower—and reverse them at the next trimming. We had a case with 25 inner globes which the trimmer took out with him and brought in the dirty ones . This was when we started on these new lamps, but after carefully watching the lights, I found that the trimmer with care could clean the globes and make them show the light equally as good as new ones. These globes are slightly of the opal kind, we clean them out with a swab of cloth. We have two circuits of 46 lamps each, the trimmer takes one circuit a day. Our circuits are much extended so that he has a horse and buggy for going the rounds. I may say there are many times in the winter when it is impossible to clean the globes ; they are then changed and brought to the station, but that is exceptional cases. Some of our lamps are hung on guys in the middle of the streets, others are on arms about 12 feet out from the pole. We raise and lower our lamps by means of a small windlass and wire cable which I have used for about ten years. These windlasses are placed about seven feet from the ground and one handle does for all of them. I had a stool made with glass supports and also covered with rubber and rough glass to protect the man from grounds, and

we have not found any trouble in fixing a lamp when needed. With regard to inspection of lamps, the trimmer goes round when the current is put on the lamps to see if they all start up. There are sometimes in the winter when some of them will stick, but a shake of the cable will generally start them. The number out will average about 20 a month during the winter, and in the summer it is a rare case to have a lamp reported out, as after they are started they rarely go out. When a lamp is reported out two nights it is taken in and repaired. We had 10 extra when we put in the system; we have still the 10 spare ones, as the repairs have been light since the first winter. We have no patrol man during the night. We make enquiries at the police station if any are reported out. It is only during the winter when an occasional one may be out a short time. I may say the council and citizens are much pleased with the new lamps, and owing to the opal globes the light is not hard on the eyes when driving near the lamp, and yet the light seems to be better and throw further. I trust, gentlemen, that I have not wearied you in these remarks about our arc lighting system, which we think is the best, at least for small plants, and I have no doubt for large ones. I will be glad to show any of you our station should you be in the vicinity of our back woods. (Applause).

Mr. Martin: A great many of you know we have adopted the series alternating arc light system for street lighting. We have had nearly eighteen months' experience, and while we have had our troubles, things are now settled down and are more satisfactory both to the company and to the citizens. When we first started we used the opal inner chambers. They no doubt diffused the light more but they certainly cut it down and we found them harder to keep clean. We are now using a clear inner chamber on all our street lamps. They give a sharper light and more like the old direct current lamps without the shadows. Regards trimming. We have two city trimmers and a patrolman. The trimmers each have a rig which is fitted up with boxes to carry the chambers in, made something after the style of an egg case. There are also pockets for the carbons in these boxes. In the front of the rig he carries a spare lamp and an extra globe or so. Each man has about 210 lamps to look after, he does the changing and any small repairs. We bring in all the inner chambers when trimming and they are replaced with clean ones each time. The ones taken off are returned to the station and are washed in a solution of washing soda and warm water, after being rinsed in clean water they are placed on pegs to dry ready for the next day. We consider this a better way, rather than leaving them to the trimmer to clean on the street as the chances are he will only half wipe them and at his best he leaves them streaked. This goes on from bad to worse and this deposit in the chamber cuts down the light considerably. We use a pear-shaped chamber which has no opening in the bottom, and we find this is better than the open type, inasmuch as it does not allow a current of air to pass through which would reduce the life of the lamp. Of course, ordinary care must be used to keep these tight up to the gas check. The carbons are all passed through a gauge before going out, and only those within the limit .505 to .520 are used, as any over size might cause the lamp to go out by sticking in the gas check, and if under size it will reduce the life of the lamp by letting the gas escape too freely. We find it better to bring in the upper carbons at each trimming, and these are cut the proper length ready for the next day to be used as lower carbons with the new uppers. The idea is to be sure that the carbons are the proper length, for if too long it burns into the gas check, and if too short it shortens the life of the lamp or burns into the lower carbon holder. A word regarding the patrolman. He has a rig and drives round the city twice each night and sees the lamps at least three or four times each. He makes out a report and also marks any lamps to be changed. Each trimmer sees the patrolman's report in the morning and makes any changes necessary. Our commercial trimmer does work very much the same only he has no rig and has to inspect his lights during the forepart of the evening and takes in any city lights on his route, which is right through the centre of the city. (Applause).

Mr. Fisk: I would like to ask how the lamps are put out in Hamilton and whether they have any trouble with open circuits.

Mr. Martin: I don't think we have. We have not had as much, at any rate: we have been a little more particular; and the lamps have been put right on the same poles and brackets as the old open arc lights. There is a rope which goes through a pulley on the pole and then there is a hook; the cleaner has a rope with a hook and he snaps it on and pulls it down.

A member: When using the carbons a second time, and trimming the lamps a second time, what average light do you get on the lamps?

Mr. Martin: There is no doubt but under the system we use of trimming, the lamp will burn over 80 hours.

The President: What length of carbons do you use?

Mr. Martin: Ten inch upper, and 5 1-2 inch bottom.

The President: Do you find that the most economical length?

Mr. Martin: Our lamps are made for that, that is all we can get.

The President: I suppose the lamps may vary with different makers, but the question I had in my mind was what was the best length of carbon to use, which gave the least waste?

Mr. Martin: Ten inches seems to be very good because if you use a much longer carbon you get a heavy deposit on the chamber and it cuts down the light.

The President: I had reference to the piece you throw away.

Mr. Martin: We don't practically throw any away. The trimmer practically gets it the proper length.

TOPICAL DISCUSSION ON DIFFERENT SYSTEMS OF CHARGING FOR AND MEASURING POWER CONSUMED BY INDUCTION MOTORS WITH VARYING POWER FACTOR.

The President stated that Mr Leyden had been asked to open the discussion on this topic, but he not being present Mr. Leonard had consented to speak on it.

Mr. Leonard: I have not prepared myself to talk extensively on this subject, and thought I would be preceded by others who had more practical experience perhaps than I had. I regret very much the absence of the other gentleman who was to speak on this subject. The matter of charging for induction motors is a question of the highest importance to transmission companies, the bulk of whose business may, in the near future, become power business; and the question of deciding upon a proper rate for charging or metering is something that will interest a good many of us I think now, and probably later will reach almost everybody operating a central power station. Of course, there are a variety of methods before us. There is the method of charging a fixed rate per H.P., and that is in a measure modified by the amount of power that is used on the average. If a man is charged for instance at the rate of $50 a H.P. and he uses his motor perhaps with an average load of half of its capacity it would pay the company a very good revenue. If he used the 50 H.P. continuously through ten hours of the day the company is not making very much money, particularly if the load laps over their incandescent lighting load. In charging a fixed rate for power it has been suggested, and carried out, that the time for using the power should be limited to certain hours so as to prevent lapping on to the lighting load. If consumers can be obtained on this basis, of course the same apparatus which is used to operate the motor load during the other part of the day can be used and the power again sold to other customers for lighting purposes later. Under these conditions a very favorable rate can be made with power consumers, and if proper effort is made in this direction it seems to me a large amount of power could be connected to the central station on a paying basis not only to the lighting company but to the consumer of power. The rate can be made enough lower to make it an inducement for a man to shut off his power at an earlier time in the day, as touched upon in Mr. Robertson's paper. Mr. Robertson covered so fully and exhaustively and in such concise language the whole subject that it leaves very little to be said now. The method of charging on a meter basis for motor load is necessarily a heavy tax on the consumer of power because if a man is allowed to use his motor at any hour of the day the central station must protect themselves by having sufficient apparatus to supply not only during the hours outside of the lighting load, but enough in addition so as to carry them through the peak of the lighting load; apparatus, in other words, must be supplied to furnish current for lights and motor load as well and under such conditions the companies must have a price which will pay them for carrying this reserve apparatus. The subject is one that would admit of considerable discussion, and I would like to hear from some of the central station men who have had a little experience with this matter. Perhaps Mr. Robertson can give us a suggestion.

Mr. Robertson: I think after what I said this morning there is very little that I could suggest that would be of interest. As you all know most central stations do not provide motors for their customers. In a few isolated cases they have done so, but in the great majority of cases the customers have to get their own motors. If a customer buys his own motor it all depends on where he gets it what power factor it has. A customer may buy a motor with a power factor of 100 or 75, which means a considerable difference in capacity the supply company must provide and keep for his use. While it has been usually the practice to sell power on a basis of true energy, it would, I think, be more equitable to sell the power on a volt-ampere basis and then it would be to a customers' interest to get as good a motor as possible. If a customer had skilled operators available and felt

like putting in a synchronous motor he could operate with a power factor of unity, and as this would be of considerable advantage to the central station, I think it would be worth while to offer a slightly reduced rate to such a man. It seems to me there is a point somewhere between charging on a true energy basis and on a volt-ampere basis, that would be more equitable than the present system.

Mr. Nicholls : I would like to get the experience of the central station men as to the possibility of getting customers to take power during certain hours of the day; for instance, a manufacturer shutting down at four o'clock or before the peak of the lighting load commenced, in order to get a rebate in price from the central station company. While a manufacturer might be perfectly willing to do that would it be possible for him to be able to induce his employes to work under these conditions ? In other words, if you are going to get the full weeks' work, whatever it is, if you close down at four o'clock you would have to compensate for that time by starting early in the morning or giving up the Saturday afternoon holiday. Mr Reesor and Mr. Fisk both come from points where there is considerable manufacturing and would know probably the position of affairs with the manufacturers there.

Mr. Sangster : I may say with regard to our plant, we are trying to obtain customers to whom we can supply power in the winter time up to four o'clock. We have quite a few of them in that way. We average about 90 H.P., down to 1. During the winter months, from October to March, we get them to shut off at four o'clock, and we have found no difficulty in doing that. It is mostly places where there are grist mills and things of that kind that we have any difficulty ; and then we have four or five newspaper presses, where they are using it; they are very often shut off at four o'clock. So that we are able to do it in that way. By giving them a lower rate we are able to get customers in that way.

Mr. Reesor : Our experience so far has been somewhat limited; we have not got up to the capacity of our generator as yet, and we have not had occasion to have any of them shut down, but with nearly all our contracts they do not run the 24 hours of the day; we try to persuade them to enter into an agreement to allow for shutting them down at the peak load, and so far we have had no difficulty whatever. The printing presses and smaller powers get their work done usually before that time. We allow them to do this. Instead of running those hours we sometimes allow them to run over time at some other time—that is, after night. One press in particular we have that runs nearly all night for the purpose of getting their paper, which is a weekly edition, off early in the morning; they do that once a week. We have had no difficulty so far. But we have got two flour mills running by electricity and one of them runs pretty regularly the year round, 24 hours a day. Of course we can't ask them to shut down. As to the other mill, the arrangement we made with them was that they were to run in the day time only, except sometimes in the later fall they want to run all night. We do not restrict them so long as we have power to spare, and, as I have said, we have not yet got up to the limit of our power : we have more power in reserve and should we get up to the limit of our capacity no doubt we would put in the other unit that we have. In that way we will have capacity to run everybody in the town for a number of years to come. I think the idea is all right to have an arrangement to have the power shut down at the peak load ; but it is a good deal like the lighting, people that are busy do not like to shut down for anything : and of course there may be difficulty bye-and-bye but we have not crossed the river yet, and we are not going to court trouble until we get nearer to the end of our tether.

Mr Leonard : I might add a word more on this question of short hour power. One of our clients who is using a total capacity of about 3,500 H P. in motors has made a contract which is such as we have been talking of for the use of power during short hours : that is, the terms of the contract provide that the company shall not use power between the hours of four and seven in the winter months; they are at liberty to use the power at any other time all day during the summer, and all night if they wish, and all day up to four o'clock in the winter, and all night after seven o'clock if they wish. This was considered as quite an experiment to begin with on account of the large number of help employed, but in order to get in a full days' work the mill started earlier in the morning and worked nine and one half hours during the winter months every day in the week, except Sundays of course, and that cut off their Saturday afternoon holiday, that is up to four o'clock : but they had after four o'clock off every afternoon in the week. And in the summer time while the power is available during all the hours up to six o'clock we run to six o'clock and give them a half holiday Saturday afternoon. The idea that the help have in connection with this method of operating can be seen from the fact that one of the departments which was capable of operation independently of the rest of the mill petitioned to have those hours continued during the summer time so that they could get to work early in the morning and quit early at night, having all the rest of the time after four o'clock ; and that department was allowed to run on in that way. So that I think it has got beyond the experimental stage so far as the help is concerned ; I think they would be better pleased at working those hours. The help are simply very well pleased with this arrangement and I don't see any reason why it should not be carried out very generally and I think a large amount of power business can be worked up on that basis.

The President : I have here a map which has been handed to me by Mr. Thomas C. Keefer, former president of the Canadian Society of Civil Engineers, which has been printed by the Department of Ontario and which was used by Mr. Keefer to accompany an address which he made before the Royal Society of Canada, as to the water powers of Canada. He tells me that there is no other map in existence which shows the water powers of Canada like this does, it is very complete and very accurate. It shows every stream of any importance in Canada, its correct location, its elevation and also the amount of rainfall, and the annual average rainfall of each locality. To anyone who has anything to do with water power or is looking for water power or wishes to develop one anywhere, the general knowledge to be gained by this map he thinks would be quite considerable, and he left this here for the inspection of the members and stated if any of the members desired to have a copy all it was necessary to do was to leave the names with the Secretary and Mr. Keefer would be pleased to have the Government forward them a copy by mail. (Applause).

Mr. Holman moved, seconded by Mr. F. H. Leonard, that a vote of thanks be extended to Mr. Thomas C. Keefer for his courtesy in the matter of extending to the members present the mailing of a copy of this map. Carried.

Mr. J. J. Wright moved, seconded by Mr. F. Nicholls, that the thanks of the Association be tendered to Prof. Owens for the interesting paper read this afternoon. Carried.

Mr. A. B. Smith moved, seconded by Mr. J. J. Wright, that the usual amount of $125 be granted to the Secretary of this Association. Carried.

The convention adjourned to Friday, June 21st, at 10 o'clock a.m.

## THIRD DAY.

At 10.15 o'clock a.m., the President in the chair, called the convention to order.

The President : The first order of business is the report from the committee appointed yesterday to draw up an amendment to Articles 3 and 5 of the constitution regarding membership.

Mr. J. J. Wright : Your Committee on amendment of the Constitution beg to report as follows :

That Article 3 of the Constitution be stricken out and the following substituted : " The Association shall consist of honorary, active, associate and junior members. The terms ' active members ' shall include all those actively engaged in operating electrical enterprises, electrical engineers and those engaged in matters of electrical education. The term ' associate ' includes all others applying, whom the Executive Committee consider eligible to become members of the Association. They shall be entitled to attend all meetings of the Association except those of the Executive and take part in all discussions, but shall not be entitled to vote for the election of officers or be eligible for office.

' Junior membership ' shall be confined to those pursuing the studies of electrical engineering ; and no person shall be eligible for this membership for a term exceeding two years, after which they may apply for active or associate membership. Honorary members shall only be elected by a two-thirds vote of the active members present.

It is recommended that for Article 5, at present in the Constitution, the following be substituted : " The annual fee shall be for active and associate members $3, the Executive, however, being authorized to increase this fee to a sum not exceeding $5 at any time they may deem it expedient in the interests of the Association. The fee for junior members shall be $1 per annum payable in advance."

Mr. J. J. Wright : I may say that the committee after giving the matter full consideration were unanimous in making this recommendation. It will be seen that the privileges of the associate members are extended by giving them the opportunity to vote in all other matters except the single one of the election of officers.

The President : You have heard the report. This has to be approved by two-thirds of the active members present before it can become law. I would like an expression of opinion on these amendments because, since the latter was brought up yesterday afternoon, a number of members have spoken to me about some of the features contained

in these amendments and in doing so brought out some new points which were not made known to me yesterday I think we ought to get all possible light upon this subject; it should not be decided hastily and I would invite a very full discussion. This matter should be settled now for good and we should get the full sense of the meeting.

Mr. J. J. Wright moved, seconded by Mr. Fred. Nicholls, the adoption of the report.

The President stated the motion.

Mr. Geo. J. Hicks: Referring to Article 10 of the Constitution, the 5th clause distinctly states that this report cannot be considered to-day, and I submit that the discussion on it to-day is out of order.

The President: This is a very unfortunate rule, and I realized it last year when some matters were discussed It makes it practically impossible to amend the Constitution unless you start the very first morning.

Mr. Fred. Nicholls read Article 14 of the Constitution.

The President: This matter has been up since yesterday. There was a notice of motion given and discussion took place. Everybody knew this was coming up this morning; not a word of protest has been raised to the legality or illegality of the thing, and now we discover, according to the strict reading of the Constitution, the report should not be considered to-day. I think these safeguards are placed there to prevent any hasty legislation or any advantage being taken of a member who is not present at the sitting; but these things do not apply, because there has been such full notice of this action that everybody has heard of it and knows about it and expected it to be settled this morning. Under the circumstances, if it is the unanimous wish of the meeting—if there isn't a dissenting voice—I would take it upon myself to interpret the Constitution in that way, that we can set it aside for this purpose. I think it would be quite within the proper practice. (Applause).

Mr. Nicholls: I might point out while the Constitution in all corporate companies provides that you give ten days' notice of a special general meeting or annual meeting by such notice as is provided for by the by-laws, yet you can waive that notice altogether, even although the statute calls for it, providing you have every shareholder's consent to it; and that is frequently done in the organization of companies, by having a waiver from every shareholder of the notice of the meeting. In this case, if there is an unanimous vote, that notice I think can be waived, but in the event of there being a dissenting vote, even one, I think we will have to carry out the strict reading of the Constitution.

Mr. Hicks: I would agree with Mr. Nicholls' remarks if every shareholder would waive that point; that it would be perfectly right to deviate from the regular order; but this matter was brought up yesterday and every member of the Association is not present to-day, and I personally know one gentleman who left the city last night knowing this could not be discussed to-day. I must personally raise my objection to it.

Mr. Nicholls: I would state that probably the only way to get over the difficulty would be to have the President call a special meeting for to-morrow; that is if the general sense of the meeting is in favor of the passage of the amendments.

The President: I think it would be well to take the sense of the meeting because if the sense of the meeting was against it there would be no use calling the meeting.

Mr. J. J. Wright moved, seconded by Mr. E. E. Cary, that when this meeting adjourns this morning that it stand adjourned until to-morrow. Carried.

Mr. Nicholls: In order to test the sense of the meeting I would suggest that the yeas and nays be taken upon the principle as outlined in the amendments that it is proposed to bring before the meeting of the Convention at its session to-morrow morning.

Mr. Leonard: I would second a motion to that effect.

The President: This is a large gathering, and I think it is very desirable that the feeling of the members should be known upon this point. This Association has to be governed in accordance with the wish of the members and we desire to know what their wishes are.

The President asked those in favor of the Constitution being amended in accordance with the report of the Committee to signify it by rising.

The members rose unanimously, with the exception of Mr. Hicks.

Mr. J. J. Wright: I asked that the contrary vote be called for.

The President called for the contrary vote. (No response).

The President: The next thing we have to deal with is the selection of the place for holding the next convention. I may state in justice to Mr. Evans, of Quebec, who attended the first day and was compelled to go away, that he left in my hands an invitation to the Association to meet next year in Quebec.

Mr. G. U. G. Holman: My residence is in Quebec, but the business of my company is on the other side of the river, however, I want to second Mr. Evans' invitation, and I hope you will hold the next convention in Quebec. As far as my company and myself are concerned we shall be very, very happy to make your stay there a pleasant one and we will try to come up to the hospitality that Ottawa has given you.

Mr. John Yule: I move, to test the sense of the meeting, that the next convention be held in Toronto. As far as I am concerned I have my doubts as to a meeting in Quebec being successful in point of attendance. It is a little too far to one side for those who usually attend. There would be a large attendance in the neighborhood of Quebec. We have been in Montreal and Kingston, and we are east again this year, and I think the west ought to get a turn. It is very central in Toronto for the whole country, and a meeting there I think would be a successful one.

Mr. F. Nicholls: While I may say, speaking for Toronto's interests, that we would be very glad indeed to welcome the Association there next year, I really think we will be in a very much better position to do so say a year later. We are having a new hotel built at the present time which will not be finished next year, but I think it will be finished and will give first-class accommodation to the convention if they will meet there a year later. At first I was inclined to Mr. Yule's opinion that we might prejudice the attendance if we went so far east; and the travelling expenses are very considerable. These things have to be considered as an important factor; in fact they are a very serious power factor with them. But I think we might probably be affected in another way, and while for one session we might lose the attendance of some of the active members from the west the chances are that we will get a very large attendance from the district of Quebec of central station men that never yet have attended unless they became members. That is a question that some of the Montreal and eastern men can tell better than I can. I do not know but what the end might justify the means and we might get an increased membership there; and if we met in the west another year when we had every facility to take care of the members it would probably be better. However, should you decide to come to Toronto both Mr. Wright and myself will do all we can to make the stay of the members pleasant and profitable.

The President: Two places have been mentioned for holding the next convention, the City of Quebec and the City of Toronto. Unless you have some other place forthcoming I shall call for a ballot and I will appoint Mr. Thornton and Mr. Purcell to act as scrutineers.

Mr. J. J. Wright: Is it in order to move that the acceptance of the invitation from Quebec be made unanimous?

Mr. Yule: I would be pleased to withdraw my motion. It was simply made for the purpose of getting an expression of opinion.

The President: Mr. Yule withdraws his motion so that the City of Quebec will be our next place of meeting. (Applause).

Mr. Nicholls: As the Constitution provides that this should be decided by ballot, I move that a single ballot be cast by Mr. J. J. Wright. (Mr. Wright cast the ballot).

The President: I am personally gratified that you have chosen the City of Quebec. I know something about that city and I am satisfied that you will get a very fine reception there. The people of Quebec are noted for their hospitality and I am sure the convention there will be a success and will be worth the few dollars you will be asked to spend in order to go a greater distance from home. The next order of business will be the election of officers, and I will ask Mr. Thornton and Mr. Purcell to continue as scrutineers. I will now receive nominations for the office of President of the Association.

Mr. F. H. Leonard, jr.: It gives me much pleasure to nominate for the office of President of this Association for the ensuing year our present vice-president, Mr. E. E. Cary.

Mr. E. E. Cary: I appreciate the nomination from Mr. Leonard, but before passing it in I wish to say as a member attending upon the convention at Hamilton that I am specially pleased with the provisions for the amendment of the Constitution which I regret could not be carried out to-day, because those who were present at Hamilton will recollect a discussion that took place as to whether supply men were eligible to the offices of this Association. In the past a number of them had served upon the Executive Committee, but I believe it happened that no one engaged in manufacturing or who was called a supply dealer had ever been elected as an officer of this Association, and a discussion took place at that time and resulted in a difference of opinion, and, although a supply man was elected as an officer of this Association, I feel we should all be a unit, and the amendment of the Constitution will settle that matter, and it will be acting in ac-

cordance with our sister Association on the other side. Therefore, I beg to decline the nomination, and I have great pleasure in nominating Mr. P. G. Gossler, of Montreal, for the office of President of this Association.

Mr. F. Nicholls: In rising to second the nomination of Mr. Gossler, if I am not out of order, I would like at this stage of the proceedings to move a vote of thanks to Mr. Cary, the retiring first vice-president, because to my knowledge he has been a most active member of the Association for a great many years and has always taken a very active interest. Although I am a supply man myself, I have taken the stand I have done in regard to the active men because I believe it is in the interests of the Association, I believe it is the only way the Association can grow and thrive and become of value to the interests which it represents. I have very much pleasure in moving a vote of thanks to Mr. Cary for his past services. (Applause).

Mr. Cary: Many thanks.

Mr. John Murphy: If a seconder is necessary, it gives me great pleasure to second the motion proposed by Mr. Nicholls. A convention without Mr. Cary would not be right. (Applause).

The President put the motion and it was declared carried by a unanimous standing vote.

Mr. Cary: I might say in sympathy with our absent friend Mr. Gossler that my mind was on him at that moment.

The President: Mr. Cary, you have heard the result of the motion which has been unanimously carried with enthusiasm. It gives me very great pleasure to tender to you the thanks of this Association. I do so with all the more pleasure because having been associated with you in the Executive Committee, you being First Vice-President, I have learned the value of the services which you have rendered the Association, not merely at the convention, where everyone would see you, but between conventions when you were not working publicly, but nevertheless, doing valuable work for the Association, and for which I have had occasion to be thankful. I regret that circumstances prevent you from filling the Presidential chair, which you would have so ably filled, and the action you have taken in this matter is on a par with what you have always done for the Association. Are there any other nominations? There being none I declare the nominations closed, and I will instruct the Secretary to cast a ballot for Mr. P. G. Gossler as President of this Association for the incoming term. (Applause). At this stage I would like to ask your permission to interrupt proceedings and allow Mr. Higman to present his motion with regard to the banquet.

Mr. Higman: It is not necessary for me to re-state my views. I placed them before you somewhat positively yesterday. I may just say this, however, that for the past ten years we have been devoting from $100 to $150 a year for this banquet. I am of opinion if this money were devoted to the building up of a library for the Association or the distribution of literature among the members of the Association or even applying it to our friend's committee for legislation work that it would be infinitely better spent than it is for the purpose of a banquet. I will therefore move, seconded by Mr. J. J. Wright, that the funds of this Association be not hereafter used for the purposes of entertainment at the Annual Convention either by means of a banquet or otherwise, but that the local entertainment committee at the place where the convention is held be permitted to make such arrangement for entertainment as they may deem expedient and necessary.

Mr. Nicholls: There is one question I would like to ask. You specify that the local committee make arrangements for a banquet, but according to that it would seem to shut out the members of the Association from at any time having a banquet of their own by an assessment for a ticket. That is not intended.

Mr. Higman: No. It leaves the local committee free to do whatsoever they please. For instance, we have collected $300 on this occasion outside of the grant. If we had provided a luncheon at the Victoria Hotel at Aylmer which the ladies could have attended, we could have done it very nicely out of the amount collected by the local committee without touching the Association funds at all. I don't think it will deprive us from any of our pleasure by adopting a resolution of this kind.

The President: There is a point that ought to be brought out in connection with this. It seems to me that the banquet ought to remain on as an annual feature or be abolished as a free banquet positively. This is the position of a city where the convention is to be held. There has been a banquet every year, for which no charge has been made; that is the custom. No one cares to depart from the annual custom and if the convention was to be held in Ottawa next year I would feel bound to continue that practice. Nobody likes to take the first step and change this and perhaps be accused of want of hospitality. In order to remove such embarrassment, if it is decided to do away with the banquet as a special feature, we ought to state it and say this Association will not countenance any free banquet, and then that ties the hands of the local committee in Quebec so that there is no option and they must charge. Otherwise they might feel bound to carry on the usual custom and, not receiving any assistance fram the Association, we would be placing an additional burden upon them.

Mr. J. J. Wright: It is rather unfortunate that this has been mentioned after the place of meeting has been fixed upon. It looks rather ungracious to fix the place of meeting and then say to them, you are not going to get any more from us.

Mr. Higman: I consulted Mr. Evans yesterday and he said he was quite in sympathy with the motion. The notice of motion was given before the place was determined upon. Mr Evans thinks the funds of the Association should not be used for the banquet.

Mr. B. F. Reesor: This discussion is probably a little too early, but how would it place the local committee, the parties getting up the banquet, when there is a charge being made? They wouldn't know how many seats to provide for or anything at all.

The President: I think that could be gotten over all right.

Mr. F. H. Leonard, jr.: Mr. President, I think the question of a banquet is one that is already settled. I don't think there is any doubt but what we shall continue to have banquets in the future just as we have in the past, they are one of the pleasantest features of our gatherings and I am sure for my part I should not hesitate to contribute my share; and as has been the case before the entire cost of the banquet has not been borne by the Association, and I presume funds will be collected outside which would assist the committee or whoever has charge of that matter in carrying out the banquet and giving us just as sumptuous a feast as we have had before. Of course, if the rule is made, whether it is passed by resolution or made part of the by-laws, or otherwise, that each member shall pay one dollar, we will say, for a ticket for the banquet, or has the option of paying it, there will always be funds enough raised outside of that to put up a first-class feast. I am in favor of Mr. Higman's motion, and I only wish to express myself in this way so as to let the members realize that we are not going to go without a banquet in the future.

Mr. Higman: We may amend this by simply making it read that the funds of the Association shall not be used for the purposes of entertainment. I would not ask to deprive anyone from any enjoyment. Those resident in Ottawa, when the Civil Engineers had their meeting in this place, subscribed all the way from one dollar up to ten dollars apiece, and covered the whole expense without going out of their own body in the city and they put up a very good entertainment throughout; and I don't think there will ever be any difficulty so far as this Association is concerned in getting plenty of the good things that are going even if this resolution is passed; and, seeing that we are always hard up for funds, I do hope the Association will favorably construe this resolution. I am quite willing to amend it by stopping at the words: "That the funds of this Association be not hereafter used for purposes of entertainment".

The President: I may say that, from my own standpoint, I think as much of the banquet as anybody here, and I would be sorry to see it dispensed with as an annual feature. It is the social function of the Association and the place where we all fraternize, but I would like to say to the Quebec members that I would much rather buy a ticket to a banquet in Quebec than have it offered free of charge. (Applause).

The President put the motion as amended, that the funds of this Association be not hereafter used for the purpose of entertainment, which, on a vote having been taken, was declared carried.

A telegram was read from Mr. P. G. Gossler, of Montreal, regretting his inability to attend any further sessions of this convention.

Mr. B. F. Reesor: I think it would be a nice thing for the Secretary to send a telegram to Mr. Gossler saying that he has been unanimously elected as President of this Association. (It was so ordered).

The President called for nominations for the office of First Vice-President.

Mr. Yule placed in nomination Mr. B. F. Reesor, seconded by Mr. E. D. McCormick.

Mr. John Murphy moved, duly seconded, that the nominations close. Carried.

The President: I have much pleasure in declaring Mr. B. F. Reesor, of Lindsay, elected to the office of First Vice-President of this Association. I may say from having come in contact with Mr. Reesor in the Executive Committee that the Association has made a very wise choice.

The President called for nominations for the office of Second Vice-President.

Mr. E. E. Cary placed in nomination Mr. Edward Slade, of Quebec City, seconded by Mr. O. Higman.

On motion, duly seconded, the nominations were closed.

The President : I have pleasure in declaring Mr. Edward Slade, of Quebec City, elected to the office of Second Vice-President of this Association.

The President called for nominations for the office of Secretary-Treasurer of the Association.

Mr. Smith placed in nomination Mr. C. H. Mortimer, seconded by Mr. B. F. Reesor.

On a motion duly seconded, the nominations were closed.

The President : It gives me very great pleasure to declare Mr. Mortimer elected for the twelfth time Secretary-Treasurer of this Association. I think possibly Mr. Mortimer, in accepting re-election, will feel relieved that a new president has been elected, because during the year I have been particularly hard on him. The correspondence with him has filled quite a little volume.

The President : T e next thing in order is to select out of the members of the Executive Committee of the past year five members who are to remain on, allowing the other five to retire.

Mr. O. Higman : I would ask that my name be omitted from the list this year.

Voices : No, No.

The Secretary passed the ballot.

The President : While we are waiting for the result of the ballot I might announce to you that the Local Manager of the Bell Telephone Company sends a cordial invitation to the Association to visit their building after adjourning this morning. (Applause).

Mr. John Murphy moved, seconded by William Ahearn, jr., that the thanks of this Association be tendered to the Corporation of the City of Ottawa, the Directors and officials of the Ottawa Electric Railway Company, the Directors of the Ottawa Electric Company, the Ottawa Power Company, the Bell Telephone Company, the Great North-Western Telegraph Company, the Hull Electric Company, the Capital Power Company, Mr. T. C. Keefer, and to Messrs. Ahearn and Soper for the generosity and kindness shown to the members of the Canadian Electrical Association during this the 11th annual convention. Carried unanimously.

The President announced the names of the five members re-elected on the Executive Committee as follows : Messrs. J. J. Wright, Toronto ; John Yule, Guelph ; A. B. Smith, Toronto ; W. H. Browne, Montreal ; and Ormond Higman, Ottawa.

The President called for nominations for five new members to be elected to complete the Executive Committee.

Mr. A. B. Smith placed in nomination Mr. A. A. Dion, seconded by Mr. F. Nicholls.

Mr. G. L. Hicks placed in nomination Mr. J. W. Purcell.

Mr. F. Nicholls placed in nomination Mr. A. Sangster.

Mr. J. Yule placed in nomination Mr. J Murphy.

Mr. R. M. Robertson placed in nomination Mr. F. H Leonard, jr.

Mr. Leonard : I beg to decline. I do not care to act on the Executive Committee, as I pre er to see central station men pure and simple act there.

Mr. Murphy : On account of Mr. Leonard's diversified connections I think he should be on the Committee.

Mr. B. F. Reesor nominated Mr. F. Simmons.

Mr. J. J. Wright nominated Mr. R. M. Robertson.

Messrs. W. G. Holman, Professor Owens and K. B Thornton were also nominated.

On a motion, duly seconded, the nominations were closed.

The President asked Messrs. Fisk and McCormick to act as scrutineers.

Mr. J. J. Wright asked the President, Mr. A. A. Dion, to vacate the chair, and requested Mr. Leonard to take the chair.

Mr. J. J. Wright : It is no doubt very apparent to you why I was so anxious to forestall the result of the elections in many ways and get Mr. Dion out of the chair as quickly as possible. It is simply for the purpose of asking you to endorse a resolution that the heartiest thanks of the Association be tendered to Mr. Dion for his services to the Association during the past two terms. Not only this year but last year under extremely difficult circumstances Mr. Dion has spent a great deal of his time, which has been taken from very important matters, as you are no doubt well aware, to further the interests of the Canadian Electrical Association. I have much pleasure in moving that the most cordial and hearty thanks of the Association be tendered to Mr. Dion for his services in the past. (Applause).

Mr. Fred Nicholls : Mr. Chairman, I feel it quite a privilege to be asked to second this motion. I made some little reference to Mr. Dion and his ability as presiding officer, at the banquet last night I have been at a very great many meetings of different kinds, and I must say the dignity and acceptability with which Mr. Dion has presided at these meetings would be difficult to surpass. I have much pleasure in seconding the motion that a hearty vote of thanks be tendered to Mr. Dion as the retiring President of this Association.

Mr. Leonard : Gentlemen, you have heard the motion.

Mr Nicholls started singing "For he's a Jolly Good Fellow," in which he was joined by all the members present, after which three cheers and a tiger were given for the retiring president, and the motion declared carried unanimously.

Mr. Leonard left the chair, President Dion resuming.

The President : I would find it difficult to express to you my appreciation of your kindness in the demonstration you have just made in my behalf. I can assure you I have deemed it a great honor to be elected to the Presidency of this Association when there are so many other men in it with more experience and who were more worthy of filling the chair than I was. When I was re-elected for a second term I can say I really did not desire it because I was under the impression, and I am still, that it is more advantageous to a society of this kind to change its president every year. However, last year circumstances seemed to make this desirable in the view of some of the members and I consented to serve a second term and I may say during this time the work connected with the office has been a labor of love and I feel it doubly so when I find anything I have been able to do is so well appreciated by the members of the Association. I thank you very much, and I regret to leave this chair, I feel so well in it. However, in one sense I am glad to give the opportunity to some one else to do the work, as my own private work has left me very little time to devote to the Association, and will leave me very little time during the coming year, but it is my purpose to stick just as closely and to work just as hard for the interests of the Association as if I were filling the presidential chair. (Applause).

The President announced the names of the five new members elected to the Executive Committee as follows : Messrs. A. A. Dion and J. Murphy, Ottawa, A. Sangster, Sherbrooke, Que. ; W. G. Holman, Quebec, and K. B. Thornton, Montreal.

The President asked if there was any other business to bring before the convention. There being no response, he declared the convention adjourned until Saturday, June 22nd, at 10 o'clock, a.m.

## FOURTH DAY.

The meeting opened at 11 a.m., the President, A. A. Dion, in the chair.

Moved by John Murphy, seconded by W. G. Bradley, and resolved, that in accordance with the proceedings taken during this convention with regard to the amending of Articles III and V of the Constitution of this Association, the said Articles be and are hereby rescinded, and shall be and are hereby replaced by the following :

Article III.—Membership.—The Association shall consist of honorary, active, associate and junior members. The term "active member" shall include all those actively engaged in operating electrical enterprises, electrical engineers, and those engaged in matters of electrical education. The term "associate" includes all others applying whom the Executive Committee consider eligible to become members of the Association. They shall be entitled to attend all meetings of the Association except those of the Executive, and take part in all discussions, but shall not be entitled to vote for the election of officers or be eligible for office. Junior membership shall be confined to those pursuing the study of electrical engineering, and no person shall be eligible for this membership for a term exceeding two years, after which he may apply for active or associate membership. Honorary members shall only be elected by a two-thirds vote of the active members present.

Article V.—The annual fee shall be for active and associate members \$3.00, the Executive Committee however being authorized to increase this fee to a sum not exceeding \$5.00 at any time they may deem it expedient in the interests of the Association. The fee for junior members shall be \$1.00 per annum, payable in advance.

No other business being forthcoming, the President declared the convention closed.

## Dominion Electrical Standards.

By O. Higman, Ottawa.

In 1894 when Parliament passed The Electrical Units Act (Schedule A.), the writer was called upon to procure the apparatus necessary to produce and express the standards therein legalized.

In seeking for guidance in the discharge of this important and responsible duty, I naturally turned to the brilliant work accomplished by the Committee on Electrical Standards appointed by the British Association in the seventies, and the no less brilliant work accomplished by the Electrical Standards Committee of the Board of Trade and contained in their report to Parliament in 1891-92. The results of the labors of these committees will, I venture to say, be found to be one of the most interesting and instructive chapters in the history of electrical science. At the period when they commenced their labors the experimental sciences of electricity and magnetism were, for the most part, mere collections of qualitative results estimated by means of units which were altogether arbitrary. The work of the committee changed experimental electricity into an exact science by adopting the C. G. S. system as their fundamental basis and enabling them to express their results in units that are altogether independent of instruments or surroundings. For practical purposes, however, it was necessary that the units should find expression in apparatus the accuracy and constancy of which could not be questioned. For the measurement of current and electro-motive force, both varying and unvarying, Lord Kelvin's instruments were recommended. The following apparatus has been procured by the department as Standards of Electrical measure and although not by any means complete, I am glad to be able to report that substantial progress has been made in complying with the requirements of the section 3, of The Units Act.

### STANDARDS OF RESISTANCE.

Three standard ohms, two of the Board of Trade and one of the Reichsanstalt (Berlin) pattern.

One resistance box containing ten 1-ohm coils with suitable plugging arrangements for putting the coils in series as a 10-ohm standard or in multiple as a 1-10-ohm standard.

One Kelvin resistance coil 100,000 ohms with 10 sub-divisions of 10,000 ohms each arranged with plugs for connecting in series or in parallel or any combination of series and parallel.

One Wheatstone Bridge (Anthony pattern) with ratio coils 1, 10, 100, 1,000 and 10,000 on each side with bridge coils of tenths, units, tens, hundreds and thousands. These coils are made of manganin specially selected and the box is fitted with an electric thermometer. Measurements of great accuracy can be obtained with this bridge used in conjunction with a sensitive reflecting Darsonval galvanometer. Intercomparisons between these standards will be made from time to time and records kept of their variations.

### MEASUREMENT OF CURRENT.

For the measurement of current a set of Lord Kelvin's balances has been provided, covering the following ranges:

| | | |
|---|---|---|
| 0 to | 1 | ampere, |
| 1 to | 5 | " |
| 5 to | 25 | " |
| 25 to | 125 | " |

1 Watt balance, 100 amperes and 200 volts.

These instruments are founded on the mutual forces, discovered by Ampere, between movable and fixed portions of an electric circuit. The shape chosen for the mutually influencing portions is circular and are called by Lord Kelvin "Ampere Rings." In each of the instruments each movable ring is actuated by two fixed rings, all three approximately horizontal. There are two such groups of three rings—two movable rings attached to the two ends of a horizontal balance arm pulled, one up and the other down by a pair of fixed rings in its neighborhood. The current is in opposite directions in the movable rings to practically annul disturbance due to horizontal components of terrestrial or local magnetic forces. It is fortunate that these magnetic disturbances have been thus annulled for reasons that will be alluded to presently. In all of the balances the current goes in opposite directions through the two fixed rings, so that the movable ring is attracted by one of the fixed rings and repelled by the other. The balances were constructed specially for the department and are a modification of the ordinary type. They are intended as ultimate standards, great accuracy and permanency being guaranteed. The scale and sliding weights are taken away and the beam is made specially strong and has a pointer at each end. A scale pan is hung at each end of the beam, and the distance from coil to coil is greater than in the ordinary balance. The method of making an observation is by placing a weight of fixed amount on the left-hand scale pan, and the beam is balanced with no current through the coils; the weight is then lifted to the right-hand scale pan and the current turned on. The amount of current passing is adjusted till the beam again balances when the current will be according to the value of the weight used. Tests having an accuracy of 1-20 of one per cent. can be quickly made and with more careful manipulation, a much higher degree of accuracy can be attained.

For purposes of graduation or standardization, the silver voltameter is used. It is one of the most accurate methods for calibrating current measuring instruments. It depends on the well-known principle that when a current of electricity flows through an electrolyte, the amount of decomposition resulting in a given time is directly proportional to the total quantity of electricity which has passed in that time. For any substance 1 coulomb will always decompose or liberate at the cathode the same fixed weight of the substance and is defined as its electro-chemical equivalent. The latest experiments agree in giving 0.001118 as the electro-chemical equivalent of silver. The specification for the electrolyte is given in schedule B. A more convenient, if not quite as accurate a method is the copper cell. The experimenter should be careful to procure pure copper sulphate and plates and the use of a chemical balance. A small quantity of sulphuric acid will improve the electrolyte. The electro-chemical equivalent of copper is 0.00237, or 1.177 grammes of copper are deposited per ampere-hour, approximately.

Another method for the measurement of current and the standardization of instruments is the fall of potential or potentiometer method. The department is now installing one of Crompton's laboratory instruments of this type, made expressly to order and suitable for reproducing and comparing standards with the highest possible degree of accuracy. Standard resistances of the following capacity are furnished with the instrument for current measurement:—

| Resistance in ohms. | Maximum current in amperes. |
|---|---|
| 1. | 1.5 |
| .5 | 3. |
| .1 | 15. |
| .01 | 150. |
| .005 | 300. |

These resistances consist of a sheet or strip of metal, or a coil of wire, each provided with 4 terminals, 2 for connection to the circuit and 2 for connection to the potential leads. The resistances are made of manganin and owing to the exceeding low temperature co-efficient of the alloy, no temperature correction is necessary except for inaccuracies exceeding 1 part in 1,000 when a curve giving the temperature value of the whole range of current that the instrument is capable of carrying is supplied. The current to be measured is passed through one of these standard resistances and the fall of potential noted. If the resistance standards are properly proportioned to the instrument, the reading in amperes will be direct. Thus a standard carrying 1,500 amperes should cause a fall of 1.5 volts, each section of the instrument being equivalent to 1-10 of a volt will therefore correspond to 100 amperes. The accuracy of the apparatus for current measurement, as will be observed, is largely dependent on the accuracy with which the standard resistances are constructed.

Another method for the measurement of current by the fall of potential is that known as the "Vienna Method." A set of instruments comprising a Weston milli-voltmeter and shunt box have been procured and forms one of the most flexible, and at the same time, accurate means of current measurement. In this as in the preceding method, if the resistances are proportional to the voltmeter, the reading in amperes will be direct. The resistances in the shunt box are made of manganin alloy with practically no temperature variation and are correct to 1-5 of 1 per cent. The combination gives three full scale readings as follows:—From 0 to 1.5 amperes—from 0 to 15 amperes and from 0 to 150 amperes. Tests can be made with great rapidity and readings on each scale from a small fraction of an ampere up to the maximum can be had in the space of two or three minutes.

### MEASUREMENT OF ELECTRO-MOTIVE FORCE.

PRIMARY STANDARDS:—Two standard Clark cells; three Hibbard 1-volt cells and a set of six special standard multicellular electrostatic voltmeters by Lord Kelvin. The latter covers a range of from 20 to 3,200 volts and was specially constructed for the department as ultimate standards of E.M.F., great accuracy and permanency being guaranteed. During the two years since the instruments were first installed, the variation in the calibrating curves has been less than 1 part in 10,000. These instruments have the great advantage of being equally accurate on direct or alternating circuits. Being electro-static, they use no current and are unaffected by local magnetic conditions. They can be kept continuously in circuit and require no temperature correction.

The instruments are calibrated by comparison with the difference of potential between the terminals of a known resistance through which the current is being measured by means of a Kelvin standard centi-ampere balance or by the potentiometer method.

Intercomparisons with the standard E.M.F. cells will be periodically made and all variations recorded. The specification for the standard Clarke cell will be found in schedule C.

THE POTENTIMOTER.—This excellent piece of laboratory apparatus and its adjuncts, though equally applicable to the measurement of current and resistance more properly comes under the head of E.M.F. standards for treatment. The fall of potential method of making measurements originated with Poggendorf, but the credit for developing the system from a crude workshop method up to what may fairly be described as a scientific instrument of no mean calibre, mainly belongs to Mr. R. E. Crompton, of London. Measurements from the lowest to the highest value may be taken by direct comparison

with the legal standard, to well within 1-10 of 1 per cent. under ordinary circumstances, whilst, by special care, a far higher degree of accuracy may be attained. The form of instrument now being furnished the department by the Messrs. Crompton, may be said to consist of 15 sections of wire connected in series, 14 of which are in the form of coils within the instrument, the 15th being stretched along a scale suitably divided; they are accurately adjusted with each other, so that with a fixed E.M.F. of 1.5 volts over the whole each section has a fall of 1-10 of a volt, the scale beneath the slide wire having 1,000 divisions each, corresponding therefore, to 1-10000 of a volt. The unknown quantity to be measured is placed in series with a galvanometer attached to the movable contacts on the slide wire and is so connected up that its E.M.F. opposes that of the main circuit of the instrument. No deflection of the galvanometer takes place when the point of balance between the opposing E.M.F.'s is obtained. The value of the comparison is then read from the scale. The instrument is calibrated by substituting for X a known value or standard—in this case a standard Clarke's cell—its temperature noted, and the contacts on the slide wire placed upon the figures corresponding with the value of the cell which would be 1.434 or 14 and 31. Resistance is added in the main circuit until there is no deflection on the galvonometer due to the fact of the E.M.F.'s in the main and galvanometer circuits being equal; the instrument is thus standardized from what afterwards becomes the X circuit and is then ready for obtaining the value of unknown E.M.F.'s. Multiples and submultiples of the ohm are used to vary the range of the instrument. They are so proportioned that their maximum carrying capacity is some definite value proportional to that of the instrument (1.5 volts) and it is entirely upon them that the range of the apparatus depends. Given proper standard resistances, the range of the instrument is practically illimitable.

Weston standard voltmeters are used as secondary standards of E.M.F., both for direct and alternating current.

One of these, for alternating current work was specially made for our laboratory and has its coils and working parts immersed in oil, thus making it absolutely "dead beat" in its operation. It is supplied with a differential scale giving readings to 1-5 volt. These voltmeters are furnished with multipliers giving ranges from 0 to 1,500 volts, and accurate to within 1-10 of 1 per cent.

### MEASUREMENT OF ELECTRICAL ENERGY.

ONE STANDARD KELVIN WATT BALANCE.—This balance is intended to measure the true energy developed in an inductive alternating current circuit. It is similar in form to the Ampere Balances, but the movable coils are wound with fine wire. These coils are of low resistance and are joined up in series with a large non-inductive resistance in a potential circuit across the mains, while the fixed coils carry the whole current to be measured. Three sets of weights are supplied with the instruments, weighing respectively 1.7564 grms., 4.3910 grms. and 17.5640 grms. The constant for each set of weights with 1,000 ohms in the fine wire circuit is 2 watts, 5 watts and 20 watts per division of the scale. The constants vary directly as the resistance in the fine wire circuit. This instrument has proven to be an excellent standard having been in constant use for four years with absolutely no change in its accuracy.

Secondary Watt Standards in use by the departmental officers are those of the Weston and Hoyt types.

### ACCESSORIES.

As accessories to these standards, it may be stated that two alternators are being installed and these will be operated from storage batteries thus ensuring a constant E.M.F. One of these is a 3-phase, 60-cycle machine and the other a single phase, 130 cycle machine. Both are nominally 104-volt alternators but are capable of wide ranges of variation, both in respect of voltage and frequency. Direct current measurement is made from the storage battery.

As a source of E.M.F. I have prepared 300 secondary cells giving a range of from 2 to 650 volts. Very satisfactory comparisons can be made with the absolutely steady pressure from these cells.

### PHOTOMETERIC MEASUREMENT OF LIGHT.

THE BUNSEN PHOTOMETER is used throughout the Dominion by the officers of the department. This piece of apparatus is so well known that a lengthy explanation of it before this Association would be quite unnecessary. It is known as the grease spot method and consists mainly of a wooden movable frame over which a piece of white paper is fixed with a grease spot in the centre. The two sources of light to be compared shines on either side of the disc and the practical value of the light to be measured is determined by the total brightness which that light is capable of producing on the disc when compared with the total brightness which the unit candle is capable of producing on the same surface. In order that both sides of the disc may be read simultaneously, a system of mirrors, introduced by Rudorff, is used. The sliding carriage containing this arrangement of disc and mirrors is moved along the scale until it reaches a point where the spot entirely disappears. The candle-power of the light being measured is then obtained by dividing the square of the distance of the source of light from the screen by the square of the distance of the standard candle from the screen. Notwithstanding the fact that the sperm candle is not a first-class standard, fairly accurate work can be done with it. The incandescent lamp is now more or less used as a secondary standard for the practical measurement of light, but the system is dependent on too many conditions being fulfilled to be accepted with any degree of confidence. Sir William Preece, among a number of others, considered that an incandescent lamp of a given type, coming from the same maker, present only insignificant differences among themselves with respect to luminous intensity and efficiency, and he was of opinion that a very convenient standard of this kind sufficiently exact for most purposes might be obtained. The subject of photometery and light standards is, however, a very large one and had better be reserved for treatment on some future occasion.

In conclusion, I would like to say just a word or two with reference to the accommodation afforded by the department as a standardizing laboratory. The room at present occupied in the Inland Revenue Department is altogether unsuited for the purpose. The flooring above and below is laid on iron joists, and these are supported by massive iron girders and columns. If the magnetic conditions surrounding these masses of iron were constant and unchanging, the errors due to their presence might, in a large measure, be compensated for; but unfortunately, live wires run over and along these girders, and the generating units are operated in their midst, rendering at once a condition of affairs anything but harmonious in so far as the use of delicate and sensitive instruments are concerned. Fortunately the Kelvin standards for current and E.M.F. are not affected by local magnetic conditions, but the sensitive galvanometers are very seriously affected and accurate work with such instruments is almost, if not quite an impossibility. It is hoped that the Government will, in the near future, provide more suitable accommodation for the work.

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## SCHEDULE A.

### THE ELECTRICAL UNITS ACT.

**1.** This Act may be cited as *The Electrical Units Act.*

**2.** The units of electrical measure for Canada shall be the following:—

(*a.*) As a unit of resistance, the ohm, which is based upon the ohm equal to $10^9$ units of resistance of the centimetre-gramme-second system of electro-magnetic units, and is represented by the resistance offered to an unvarying electric current by a column of mercury, at the temperature of melting ice 14·4521 grammes in mass, of a constant cross-sectional area and of the length of 106·3 centimetres.

(*b.*) As a unit of current, the ampere, which is one-tenth of the unit of current of the centimetre-gramme-second system of electro-magnetic units, and is represented sufficiently well for practical use by the unvarying current which, when passed through a solution of nitrate of silver in water, and in accordance with the specification contained in schedule one to this Act, deposits silver at the rate of 0·001118 of a gramme per second.

(*c.*) As a unit of electro-motive force, the volt, which is the electro-motive force that, steadily applied to a conductor whose resistance is one ohm, will produce a current of one ampere, and which is represented sufficiently well for practical use by $\frac{1000}{1434}$ of the electro-motive force between the poles or electrodes of the voltaic cell known as Clark's cell, at a temperature of 15° centigrade and prepared in accordance with the specification contained in schedule two to this Act.

(*d.*) As a unit of quantity, the coulomb, which is the quantity of electricity transferred by a current of one ampere in one second.

(*e.*) As a unit of capacity, the farad, which is the capacity of a condenser charged to a potential of one volt by one coulomb.

(*f.*) As a unit of work, the joule, which is equal to $10^7$ units of work in the centimetre-gramme-second system, and is represented sufficiently well for practical use by the energy expended in one second by one ampere in one ohm.

(*g.*) As a unit of power, the watt, which is equal to $10^7$ units of power in the centimetre-gramme-second system, and is represented sufficiently well for practical use by the work done at the rate of one joule per second.

(*h.*) As the unit of induction, the henry, which is the induction in a circuit when the electro-motive force induced in that circuit is one volt, while the inducing current varies at the rate of one ampere per second.

**3.** The units of electrical measure described in the next preceding section, or such standard apparatus as is necessary to produce them, shall be deposited in the Department of Inland Revenue and shall form part of the system of standards of measure and weight established by *The Weights and Measures Act.*

### SCHEDULE B.

SPECIFICATIONS FOR THE SILVER VOLTAMETER.

In the following specification, the term silver voltameter means the arrangement of apparatus by means of which an electric current is passed through a solution of nitrate of silver in water. The silver voltameter measures the total electrical quantity which has passed during the time of the experiment; and by noting this time, the time-average of the current, or, if the current has been kept constant, the current itself, can be deduced.

In employing the silver voltameter to measure currents of about one ampere, the following arrangements should be adopted. The cathode on which the silver is to be deposited should take the form of a platinum bowl not less than 10 centimetres in diameter and from 4 to 5 centimetres in depth. The anode should be a plate of pure silver 30 square centimeters in area and 2 or 3 millemetres in thickness. This is supported horizontally in the liquid near the top of the solution by a platinum wire passed through holes in the plate at opposite corners. To prevent the disintegrated silver which is formed on the anode from falling on to the cathode, the anode should be wrapped round with pure filter paper, secured at the back with sealing wax.

The liquid should consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current, some resistance besides that of the voltameter should be inserted in the circuit. The total metallic resistance of the circuit should not be less than 10 ohms.

### SCHEDULE C.

SPECIFICATION FOR THE STANDARD CLARKE CELL.

The cell consists of zinc and mercury in a saturated solution of zinc sulphate and mercurous sulphate in water, prepared with mercurous sulphate in excess, and is conveniently contained in a cylindrical glass vessel.

*The mercury.*—To secure purity it should be first treated with acid in the usual manner, and subsequently distilled *in vacuo.*

*The zinc.*—Take a portion of a rod of pure re-distilled zinc, solder to one end a piece of copper wire, clean the whole with glass paper, carefully removing any loose pieces of the zinc. Just before making up the cell, dip the zinc into dilute sulphuric acid, wash with distilled water, and dry with a clean cloth or filter paper.

*The zinc sulphate solution.*—Prepare a saturated solution of pure ("pure re-crystallized") zinc sulphate by mixing in a flask distilled water with nearly twice its weight of crystals of pure zinc sulphate, and adding zinc oxide in the proportion of about 2 per cent by weight of the zinc sulphate crystals to neutralise any free acid. The crystals should be dissolved with the aid of gentle heat, but the temperature to which the solution is raised should not exceed 30° C. Mercurous sulphate treated as hereinafter described, should be added in the proportion of about 12 per cent by weight of the zinc sulphate crystals, and the solution filtered, while still warm, into a stock bottle. Crystals should form as it cools.

*The mercurous sulphate.*—Take mercurous sulphate, purchased as pure, and wash it thoroughly with cold distilled water by agitation in a bottle; drain off the water, and repeat the process at least twice. After the last washing, drain off as much of the water as possible.

Mix the washed mercurous sulphate with the zinc sulphate solution, adding sufficient crystals of zinc sulphate from the stock bottle to ensure saturation, and a small quantity of pure mercury. Shake these up well together to form a paste of the consistence of cream. Heat the paste, but not above a temperature of 30° C. Keep the paste for an hour at this temperature, agitating it from time to time; then allow it to cool, continuing to shake it occasionally while cooling. Crystals of zinc sulphate should then be distinctly visible, and should be distributed throughout the mass. If this is not the case, add more crystals from the stock bottle, and repeat the whole process. This method ensures the formation of a saturated solution of zinc and mercurous sulphates in water.

Contact is made with the mercury by means of a platinum wire about No. 22 gauge. This is protected from contact with the other materials of the cell by being sealed in a glass tube. The ends of the wire project from the ends of the tube; one end forms the terminal; the other end and a portion of the glass tube dip into the mercury

## Balancing a 3-wire Alternating Secondary System.

By L. Denis, Quebec City.

This paper has the misfortune of having been prepared under rather short notice: its subject had to be chosen so as to be easily developed, to make the paper as short as possible. In fact the main object of this paper is to open a discussion on the relative merits of the different alternating current secondary systems.

During the past seven or eight years great achievements have been wrought in long distance, high tension transmission, and probably the efforts which these have required may account for the little attention given towards improvements in secondary systems.

Poor distributing regulation is a very common and even accepted occurrence amongst central stations; and this, if not properly checked, may very likely be the cause of a retardation in the electrical progress.

In this paper it is intended to give a short description of the method employed by the Jacques Cartier Water Power Company, of Quebec, for keeping a three-wire secondary network in proper balance. Before entering into the subject of secondary distribution proper, kindly allow a short description of the whole distributing system.

As in most distribution of any size, the city is divided into several districts, fed by separate single phase primary feeders (the power distribution being quite separate from the lighting).

In each of these districts is a main bank of transformers connected to feed a three-wire distribution (108 volts on each side). These transformers are separated from one another by properly fused junction boxes in the two outside secondary wires and set midway (electrically) between transformers. The primary feeders are regulated by means of Stillwell regulators from direct pressure readings taken at different points of each of the banks and carried back to the station by pressure or pilot wires, which are strung in the form of a cable and which show the pressure across the two outside wires on a 200-volt voltmeter, which takes a current of only .006 of an ampere. The neutral wire is also carried back to the station in the same cables and arranged on a switch so that the readings on each side of the three-wire system may also be obtained on a standard voltmeter. The outlying districts are fed from independent transformers, with which we are not concerned in this paper.

Coming now to the subject proper and considering an individual consumer—it is essential to know three facts about him before any attempt is made at keeping records:

1. What side of the secondary circuit the connection is made on.
2. What transformer in the bank the connection is made on.
3. What his approximate maximum demand will be.

Knowing these for each consumer, it is quite simple to arrive at the maximum demand on each side of every transformer, and a record thereof may be kept.

The method employed by the above-named Company to ascertain these three facts is as follows: For each consumer to be connected, a form is filled out giving the name and address of consumer; from his address the transformer he will be fed from is determined and put down, and by referring to records for this transformer, the best side to put consumer on is also determined and put down. The slip thus filled out is handed to the foreman of a service connection gang, who has to go by it in running the service wires, and returns it to the office as soon as he is through. If, however, for some reason or another, he finds it impossible to follow the slip to the letter, he is instructed to make whatever alterations are necessary, so that when the slip is handed back it shows the actual manner in which the consumer has been connected.

Now, going into further details about the three points above enumerated, little need be said about the 1st, except describing the manner in which one side of the secondary system is distinguished from the other.

The three wires are strung on a four-pin cross-arm, using three consecutive pins, the same relative position being maintained all along the bank. This construction will give you at each pole the same two wires (one outside and the neutral) separated by the pole and the other two (the other outside and the neutral), with nothing between. These two sides may be designated as "a" and "b," or "1" and "2," or any other convenient symbols respectively.

It is evident that great care must be taken in running three wire taps from a main line not to have circuit "a" of your tap conected on circuit "b" of the line and circuit "b" of tap on "a" of line, as this is certain to give rise to very serious errors.

To determine the second point, maps of the different districts of the city are maintained and kept up-to-date, as far as changes on the lines are concerned. These maps show the secondary line and taps, and the exact position of transformers and junction boxes. Knowing a consumer's address, his exact location is ascertained with the help of a city directory and the transformer feeding the nearest mains determined. The transformers are distinguished from one another by numbers painted on them after they are tested. The transformers are numbered in the order they come through, irrespective of size or the bank in which they are to be inserted.

The only difficulty to be encountered in connection with this second point, happens when a new transformer is set up to reinforce the bank. When it is found from the records that a transformer in the bank is being overloaded, which really only means that the demand per unit length is becoming greater in that part of the bank, it be-

comes necessary to have the transformers at that point nearer one another, which means that another transformer has to be inserted, and possibly the existing ones moved. To get at the best position for this new transformer, what may be termed "trial records" are made out from the original connection slips belonging to the transformer or transformers to be relieved, by placing the new transformer and its junction boxes in different imaginary positions on the map, choosing the position which gives the best results on these "trial records." These "trial records," although very nearly correct, cannot be relied upon as absolutely accurate, and an inspection of the line has to be made after all changes are completed to determine exactly what customers have been changed from one transformer to the other, and of course records changed accordingly.

The third and possibly most important point may at first sight seem very hard to determine with any degree of accuracy, but if proper judgment be used in establishing certain factors for different classes of consumers dealt with, maximum demand may easily be determined.

The factors used by the Jacques Cartier Water Power Company are governed mainly by the rate under which a consumer contracts, but in some cases also by the class of consumer to be served. For ordinary meter consumers (residences and stores of moderate size), 40 per cent of the total installation is taken as a maximum demand; for the larger stores and manufacturers individual factors are assigned, which generally vary from 75 per cent. to 90 per cent. of total installation. For consumers on the flat rate, 90 per cent. of total capacity contracted for is taken. Consumers on limited capacity system are the most easily dealt with, as naturally the maximum demand contracted for must be taken as their maximum demand without introducing any factor whatsoever.

A few figures may be of interest to show a comparison between the actual maximum demand as read on distributing switchboard meters and the total maximum demand as estimated in the manner described above for the corresponding circuit:

| Max. Dem. in lamps from switchboard meters. | Estimated max. demand. | Per cent. of actual on estimated. |
|---|---|---|
| 1,840 | 2,206 | 83 |
| 3,200 | 4,272 | 75.0 |
| 1,320 | 1,767 | 75.5 |

As figures show that the "actual" and "estimated" bear approximately the same ratio to one another in different districts, all the more will they do so on different transformers and on the two sides of the same transformer, for the factors above referred to will actually tend to be more alike in one part of the district than in different districts. So that as far as balancing is concerned, the estimated figures may be relied upon with absolute confidence.

Another proof of at least the approximate accuracy of figures arrived at by estimate may be obtained from the fact that in spite of the very rapid growth of the plant (over 30,000 lamps of 16 C.P. having been connected in about one year), and having been guided entirely by this estimated maximum demand in all changes and additions to city distribution, not one case of burnt-out transformer from overload has occurred, and only three cases of blown fuses.

It is hoped that the contents of this short paper will go towards removing some of the objections to an alternating three-wire secondary system.

## Conversion from Constant Alternating Potential to Constant Alternating Current.

By R. B. Owens, Montreal.

For purposes of economic station operation as well as economy of copper in distribution, particularly in connection with water power developments, the use of large generator units of the alternating current type can be taken as standard practice.

Assuming then an alternating current supply at constant potential, the several principal methods for its conversion for power interior illumination and street lighting may be recalled.

For power, both the induction and synchronous motor under proper operating conditions are highly satisfactory. For interior lighting excepting of large areas, the use of constant potential transformers and incandescent lamps is practically universal.

For street lighting however the case is different, there being little uniformity either as to apparatus employed or results obtained.

The following are the methods principally in use:

1. Induction or synchronous motors driving direct constant current open or closed coil, dynamos of different current capacities and open or enclosed direct current arcs, the latter type growing in favor.

2. A coil of constant or variable inductance in series with a circuit of enclosed alternating arcs, current being supplied from constant potential mains.

3. Constant alternating current transformers, usually of the repulsion coil type and enclosed alternating arcs.

Street lighting by constant potential alternating arcs and by incandescent lamps while occasionally resorted to under special conditions, need not here I think be considered, the first because of low power factor, inconvenience of central control and low ratio of energy in arc to energy supplied to lamp terminals, and the second because of comparatively low candle power—watt efficiency.

In any system of arc lighting from an alternating current source considerations of efficiency, power factor and constancy of current in lamp are of primary importance.

With regard to the first method mentioned, namely, motor generator sets and direct current arcs, its chief drawback is low efficiency, little if any better than 75 per cent. under favorable conditions.

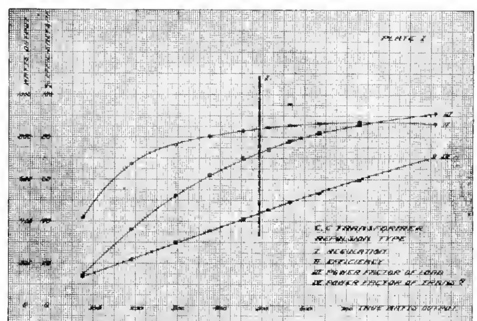
As against this, however, must be counted the advantage it affords in the use of enclosed direct current series arcs, both photometric and power measurements showing their superiority to the alternating type. The line power factor also in general is good, being from 90 to nearly 100 per cent. at full load depending on whether induction or synchronous motors are used.

The regulation of a modern direct constant current arc generator is likewise satisfactory.

In the second method, if a large inductance is used, the power factor is poor and the regulation good, and conversely with a small inductance the power factor is good and the regulation poor.

In practice it is found that a comparatively large inductance must be used to take care of possible short circuits on line which in general means poor power factor. The efficiency however is good at full load.

The third method, constant current transformers of the repulsion coil type and enclosed alternating arcs has come




rapidly into prominence in the past two years, some thirty thousand series arcs being operated in this way at the present time.

The special features of merits of this system seem to be high efficiency, close regulation, small spacerequired as compared with motor generator sets, and the insulation of the arc circuits from the generator. The power factor is, however, poor, about 80 per cent. under favorable conditions at 60-cycles and 70 per cent. at 125 cycles, and decreases rapidly with load.

For purposes of comparison, I have shown in plate I the results of a test of a small constant current transformer—one k.w. 1,000 volts, I ampere, of the repulsion coil type, not that the performance of so small a unit is as good as can be obtained in larger sizes, but, as all sizes possess certain characteristics in common, the results shown will serve our present purpose.

Curve 1, plate 1 is the regulation curve and shows that with proper adjustment the regulation may be perfect. Curve 2, plate 1 is the efficiency curve, and shows that while the maximum efficiency is not high in this particular size, nevertheless a good efficiency is maintained throughout a considerable range. Curve 3, plate 1 is the power factor of load, and curve 4, plate 1 is the power factor of the transformer and load. It will be noted that the power factor of the combination is uniformly lower than the load power factor which is characteristic of all sizes within the limits of commercial practice.

The particular object of the present paper is to emphasize another method of constant potential constant current transformation which, while known for some time, has not apparently received the attention it deserves.

I refer to the combination of impedence coils and condenser shown in plate 2, due originally, I think, to Le Blanc, and treated mathematically by Steinmetz and others.

From the theoretical consideration it can be shown that when a constant potential is applied to two equal mag-

netic reactances in series with a variable non-inductive receiver circuit, the receiver circuit and one reactance being shunted by a condenser whose capacity reactance numerically equals either magnetic reactance the current in the receiver circuits will remain constant and be independent of the receiver circuit resistance.

To test such an arrangement practically, two impedence coils, the dimensions and data of which are shown in plate 3 were constructed, their reactances being variable by the insertion of strips of rubber under their keepers, and connected in series with a smaller coil of constant reactance and a variable non-inductive receiver circuit. A 28 M.F. Condenser shunted the receiver circuits and the two impedence coils. The reactance of the two coils in the receiver circuit was made as nearly as possible equal to the reactance of the remaining impedence coil and also of the condenser.

500 volts at 55 cycles was then applied to the main circuit and the efficiency and the power factor of the combination noted as well as the current in the receiver circuit.

Plate 2 plainly shows the arrangement of apparatus and testing instruments.

In plate 3 are given the results.

As the power factor of the receiving circuits is varied from a small value to something over 80 per cent., it will be noted that the power factor of the main circuit remains throughout practically unity.

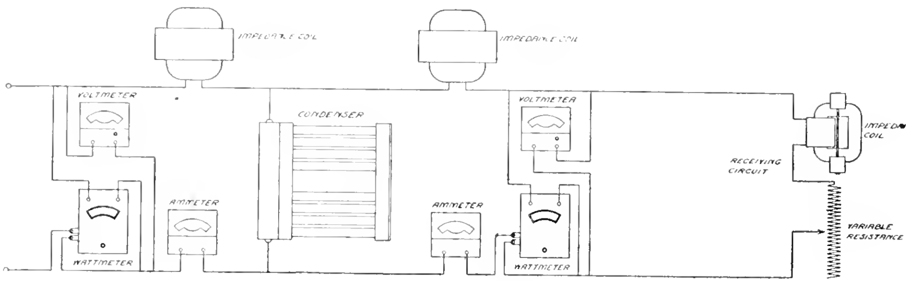
The efficiency is nearly constant through a wide range although not high in this particular case, due to the design of the impedence coils.

The regulation curve shows that the current in the receiving circuit varied only some six per cent. between half and full load, a sufficiently satisfactory result. Perfect regulation, however, can be obtained with better proportioned apparatus.

On the whole the results though not as good in some particulars as can evidently be obtained after a full development of the system are nevertheless, I think, of considerable interest to central station managers, as they clearly point to a method of constant potential—constant-current transformation possessing the characteristics of high efficiency, unity power factor, close regulation, absence of moving parts and requiring a comparatively small floor space.

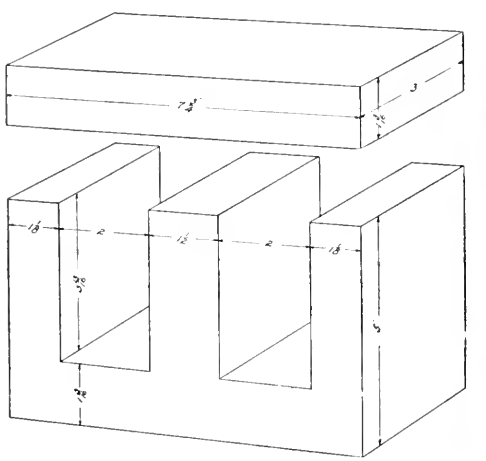
It is to be hoped that some of our larger makers will devote further attention to the method.

PLATE II




C C TRANSFORMATION
DIAGRAM OF CONNECTIONS

PLATE III

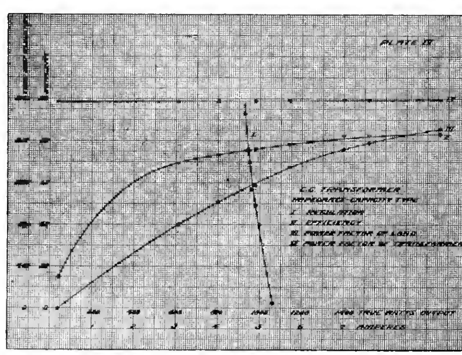


IMPEDANCE COIL
WOUND WITH 490 TURNS
NO 12 B&S WIRE
RESISTANCE .36 OHMS
16 MIL IRON

## The Influence of the Load Factor on the Design and Operation of a Lighting and Power System.

By J. R. Robertson, Montreal.

The load factor of the station is usually defined as the ratio between the average load carried by the station for the twenty-four hours and the maximum demand at the hour of the peak load. It is only within the last few years that the managers and engineers of most of our lighting companies have come to realize that the low load factor that was considered satisfactory a few years ago, and in a measure a sort of inherent inefficiency inseparable from the business, cannot be any longer regarded in this comfortable light, and that such an explanation does not in any way reconcile their customers to paying heavy bills for lighting service or make more satisfactory the receipt of small profits by the shareholders, and that in short, some means must be found whereby this factor can be increased, so increasing the output of the station



and its revenue without appreciably increasing the invesment and fixed charges.

It is unnecessary to point out to this association composed largely of managers and engineers of lighting plants, that it cannot be very economical to invest a large amount of capital in plant and then permit that plant to remain practically idle for eighty per cent. of the day, yet this is what almost all lighting plants at present are doing. In Figs. 1 and 2 we have what was considered a very fair load curve for the twenty-four hours in a large lighting station. Fig 1 shows the light summer load and Fig. 2 the winter load. On these curves is marked the average load for the twenty-four hours. This is in Fig. 1 37 per cent., and in Fig. 2, 52 per cent. of the maximum load, averaging outside of peak hours about 44 per cent. of the maximum demand in summer and about 30 per cent. in winter.

This means that of the plant installed, 70 per cent. stands practically idle for eighteen hours of the day, and in the other six hours the plant must earn enough money to pay all operating and maintenance expenses and also the fixed charges on the whole plant which remain practically the same whether the machinery is in operation or not. The fact must also be taken into account that as shown by these curves the greater part of the load at other than peak hours is composed of transformer magnetizing current which returns no revenue to the station, and that the operating charges during this period must be added to the amount chargeable against the earnings of the plant during the six hours of paying load. If a plant is to pay a dividend under operating conditions such as these, the charge for current must be enormously high; this precludes the possibility of the electric light being made popular, and

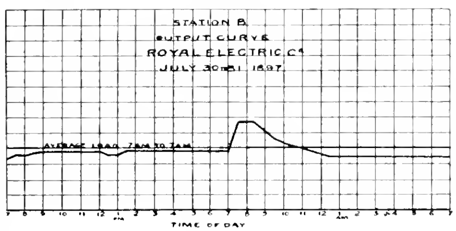



FIG. 1

confines its use to those to whom the increased price is less of an object than the increased inconvenience. With a limited patronage such as this the business cannot grow, as in every community the great majority of the people are of the class to whom the necessary increase in the price of electric light over other means of illumination is a consideration, and with whom as a rule price determines what system of lighting is used.

In selling power for the working day from seven in the morning till six at night it soon became evident that in countries as far north as Canada the hours of lighting overlapped very considerably the hours during which power was being sold. With a peak load occurring between the hours of five and six o'clock in the winter it became apparent that if the day load was to be handled economically arrangements must be made whereby this load would be off the lines before the heavy lighting load came on. To secure this end it was necessary in making contracts for power to stipulate that during the winter months power was not to be used between the hours of four and seven p.m., in most cases. A proposition of this kind is not usually met by the proprietor of a manufacturing establishment with any great cordiality, the very idea that his business could be stopped for two hours per day during six months of the year being preposterous. However on consideration the proposition is not so disadvantageous to the proprietor as at first glance it appears. When it is taken into consideration that the production of a factory is very materially reduced when working with artificial light, that the quality of the work suffers, and that the percentage of spoiled material rises decidedly, the proposition does not look quite so one sided. Add to this the fact that a stoppage of two hours out of ten per day does not as a rule lower the production except on automatic machinery more than eight or ten per cent., and that if it is absolutely necessary that the machinery be in operation more than eight hours per day

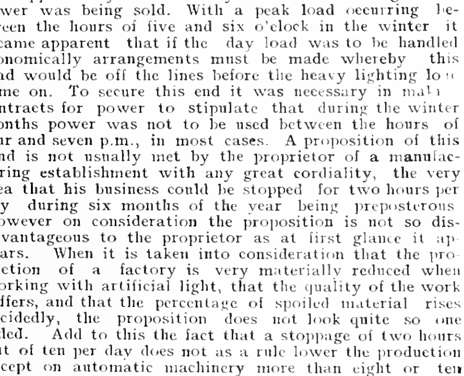



FIG 2

it is possible by starting before seven in the morning and reducing the noon hour slightly to make the week's run aggregate 60 hours, an average of ten hours per day. If this is done a very decided decrease can be made in the rates for power, and the matter if properly presented, is reasonably certain of careful if not favorable consideration. If the whole factory cannot be stopped at four o'clock as sometimes happens, it is almost invariably the case that the greater part of the machinery can and in this case the low rate for power would apply to the part the use of which was discontinued at four o'clock, a premium being paid for the use of that part which must be used during lighting hours. For service of this class it is very evident a very low charge can be made, as with water power plants there is practically no increase in the cost of production, and in steam plants the cost of the power is little more than the cost of the coal and other operating supplies.

The number of users of power under these limited service contracts is steadily increasing and it is safe to predict that it will not be many years before the great majority of the large factories, especially in cities where current is supplied from water power plants, will shut their doors before dark and the working day will be a day in reality and will not include also a part of the night.

The system of charging for power service is a matter which has a direct and powerful effect upon the extension of this branch of the business and consequently upon the improvement of the load factor, and therefore should be the subject of careful consideration on the part of the supply company.

Of the different bases for contract rates and of methods of arriving at the proper amount of power chargeable there are almost as many as there are customers. Some companies pin their faith to the flat rate per horse power under all conditions, the better informed of this class taking into account in making the rate, the nature of the business, and the probable consumption of energy. Others use nothing but the straight meter rate, arguing in defence of it that because the customer pays for the power he uses, and for all that he uses, he is therefore paying all that he should. Others again confine themselves to no particular method quoting to each customer a rate based upon the actual conditions of the customer's business, in such a way as to ensure a proper return for the service supplied. This may take the form of any of the above methods or it may be a combination of them. The latter method which is the fairest to both buyer and seller is coming to be the usual system adopted by managers

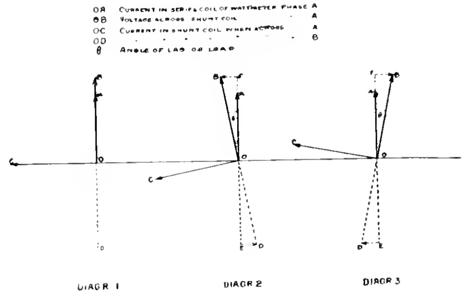



FIG. 3

who decline to make their good customers pay for the shortcomings of their bad ones. In practically all manufacturing plants there is a large fluctuation in the use of power, both from minute to minute and from hour to hour during the day and from month to month during the year. Every business has its slack seasons and if these should occur in the middle of the summer when the lighting revenue is very low it is manifestly unfair that customers to whom power has been supplied all through the season, in which light is at a premium and power valuable should be permitted to cut off their demand for power to almost nothing and leave this power on the hands of the supply company at a season when it is not marketable. This applies in a lesser degree to fluctuations in demand throughout the day. There are many cases in which heavy machinery is used for perhaps two or three hours per day and in order to supply this power transformers and connections of large size must be installed while the average power supplied for the day would not perhaps amount to one-half the capacity installed. In cases such as this it is not equitable to charge the customer a straight meter rate unless this rate is very high as the revenue derived would not pay a fair average on the capacity demanded from the supply company, which capacity must be held at the disposal of the customer at all times and consequently cannot be sold to any one else. It is better in such cases to charge a fixed rate per horse power on the maximum demand as ascertained by test and to this add a meter rate per horse power hour for the actual consumption. In this way the supply company is protected against non use by the customer, as in any case the fixed rate must be paid, and it is to the customer's interest to see that the maximum load is made as low as possible. Where the nature of the business carried on by the prospective customer is well known a straight meter rate can be made satisfactorily by inserting in the contract a stipulation that the revenue must not in any case be less than a fixed sum per month,

thus protecting the supply company against loss of revenue, and with a previous knowledge of the probable maximum demand a meter rate can be determined which will ensure a proper return for the service supplied.

One of the most serious obstacles to the development of the two rate system of charging for power has been the lack of a satisfactory two rate meter. A number of meters of this type have been designed but none of them have come into use sufficiently to permit of any conclusions being drawn from their operation. These meters are of three general types. In one the meter runs at normal speed during the period in which power is sold at a low rate and it is then speeded up during the hours of peak load, the difference in speed being adjusted in accordance with the rates for power during the two periods. Another type of meter runs at normal speed during the hours of peak load and is then slowed down during the low charge period, the ratio between the speeds being determined as above. The third type of meter is one which records the power used during the two periods on two distinct dials. This latter system is the most satisfactory from both the customer's and the supply company's point of view as the amount of power used during each period is registered and charges can be adjusted as required. It has the advantage too that the customer can understand it and consequently is more likely to be satisfied with his bills. In almost all of these meters the recording mechanism is controlled by a self winding clock mechanism which at a predetermined time cuts in resistance in series with the shunt winding of the wattmeter or in some other way slows it down and at the end of the period cuts the resistance out again. With the two dial system the recording train of the meter is connected to each dial in turn at the proper time. The limit for these meters in the past is probably accountable for their very slow development but as the necessity of improving the load factor becomes more pressing meters of this type will be more in demand and there is little doubt that satisfactory instruments will be forthcoming.

In a considerable number of cases customers will refuse to have anything to do with meters, either because they doubt their accuracy, or as is more frequently the case, because they wish to know at the beginning of the year precisely what they will be required to pay for power so that they may be able to estimate on their probable expenses. In such cases the only way to arrive at a basis on which to charge is to make careful tests of the maximum, minimum and average demand for power and on a basis of the maximum quote a rate per horse power, the amount of which is based upon the closeness with which the average approaches the maximum. In some cases it may be advisable to quote two rates, one upon the fixed part of the load, motor and shafting, and another upon the variable part. This would be more favorable to those who have a considerable amount of machinery which is in operation during only a part of the day, or during only certain seasons as the lower rate permits it to stand idle with less loss to the customer. In cases where a flat

| TRUE WATTS FROM WESTON W M | AMPERES | VOLTS | APPARENT WATTS | SECONDS PER REV OF DISC: METER Y | METER X | POWER FACTOR: FROM INTEGRATING METERS | FROM VOLTAMPERES AMMWATTS |
|---|---|---|---|---|---|---|---|
| 340000 | 275 | 2040 | 356000 | 3 7 | 1 36 | .935 | .969 |
| 320000 | 285 | 2000 | 346000 | 3 68 | 1 33 | .940 | .964 |
| 328000 | 270 | 2000 | 340000 | 3 80 | 1 40 | .938 | .976 |
| 316000 | 260 | 2040 | 330000 | 3 72 | 1 37 | .936 | .971 |
| 332000 | 260 | 2080 | 336000 | 3 64 | 1 34 | .935 | .991 |
| | | | | | AVERAGE | .937 | .974 |
| | | | EXCITING CURRENT INCREASED 50% | | | | |
| 340000 | 265 | 2120 | 360000 | 4 4 | 1 34 | .938 | .984 |
| | | | EXCITING CURRENT NORMAL | | | | |
| 325000 | 265 | 2040 | 340000 | 3 64 | 1 36 | .936 | .975 |

FIG. 4

rate is required and the opinions of the supply company and the customer differ radically as to the amount of power required a compromise can usually be effected by quoting a rate based upon the amount estimated by the customer with the stipulation that if the power required as determined by test is in excess of this amount the additional power will be paid for at the same rate, that is at the rate determined by dividing the contract price by the contract amount of power. By this method the customer is protected against the possibility of mistakes on the part of the supply company and the company is protected against the possibility of the power required being greater than was anticipated.

You will notice that in almost all cases it is recommended that the rate be based upon the maximum load demanded and not upon the average. This may at first sight appear unfair to the customer but there are good reasons for the choice. From the supply company's point of view variable loads are not desirable as they are destructive of good regulation. Any rate therefore based upon the maximum puts a penalty upon poor apparatus and a premium upon good to such an extent that customers demand from manufacturers that the machinery must keep within fixed limits of power consumption, thus benefitting the customer through his reduced bill and the supply company through the improved regulation. In Montreal this policy has materially improved the conditions of load of a great many customers more particularly those to whom power is supplied for elevator service. Passenger elevators that used to require thirty horse power to start now manage to start on fifteen to twenty and there is no noticeable diminution in their speed or service. Freight elevators that used to demand seven horse power to start under load are now started on five, and factories that used to find it convenient to operate all their heavy machinery at once, now find it economical

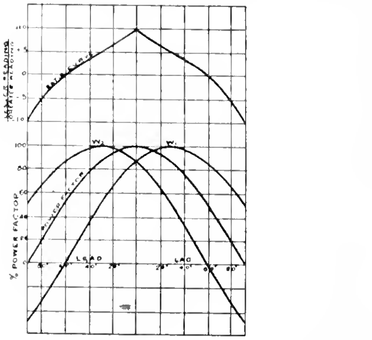


FIG. 5

to distribute the use of it throughout the day so reducing their maximum demand and making their load much more regular.

In re arranging and re-building a plant with a view of operating a combined light and power service from the same generators and circuits, one of the first questions to be decided is the frequency. In former days when the lighting service was everything, a frequency of about 16,000 alternations per minute was most common, and for the purpose was satisfactory. For exclusively power work on the other hand, the frequency most favored was in the neighborhood of three thousand or less. At this latter figure the flickering of incandescent lamps is decidedly disagreeable and the operation of alternating arc lamps is almost impossible. At the higher frequency the operation of motors is difficult, that is in large numbers and sizes as the inductive effects are great and the power factor consequently low. The result of this is a compromise. A frequency of about 7200 or 8000 is sufficiently high to permit of the satisfactory operation of incandescent and arc lamps without noticeable flickering and sufficiently low to permit of the operation of induction motors with a power factor reasonably high, and a speed reasonably low. This frequency too is about the upper limit at which rotary converters can be operated satisfactorily, so that taking into account all the branches of service, the best frequency for a combined lighting and power plant would seem to be in the neighborhood of 8,000 alternations per minute.

The frequency being decided there remains the question as to whether the generators with the transmission and distributing system shall be two phase, three phase, or some combination of the two. For a system such as is under consideration it is now pretty generally conceded that the generating plant should be two phase, as with this system the unbalancing effect of lighting on single phases has less effect on the regulation that it has on a three phase generator under the same conditions. In cases where the power has to be transmitted over a considerable distance on account of the economy in copper it is generally better to transform to three phase in stepping up to the high line voltage, and at the receiving end in stepping down transform back to two phase. In practically all cases where the lighting forms any considerable proportion of the load distribution at two phase is preferable to three phase from the regulation point of view. Three wire two phase systems, though somewhat more economical of copper than four wire systems, are not generally so satisfactory in operation on account of the higher voltage to which all appatatus connected to the lines is subjected together with the increased probability of trouble from wires coming in contact during storms and burning down. The immunity from trouble on the lines when operating a four wire system is usually considered to more than offset the increased economy. With the distribution two phase there is no trouble in connecting three phase motors when desired as the regular motor transformers can be used, the only alteration necessary being the bringing out of a lead from the middle point of one coil. This is in almost all transformers a matter involving very little work as the secondary coils are generally wound in two

halves connected together inside the transformer and it is only necessary to connect the third lead to this point and bring it out through the case. With transformers connected on the Scott system it is evident that the vertical component of the triangle of forces will be 100 instead of approximately 87 per cent. of the secondary voltage of the other transformer, thus making the triangle of voltage isosceles, two of the sides having a higher voltage than the third. This difference in voltage on a 500 volt motor amounts to about 60 volts. The effect of this unbalancing is to throw more work on two phases of the motor than on the third and while this must evidently overwork these two coils if the motor is run at full load experience shows that any of the standard motors will operate under these conditions without undue heating Of course if the motor is of large size it would be advisable to have the ratio of the transformers such that a true three phase current would be produced.

We come now to a consideration of the type of motor as an element affecting the improvement of the load factor. On this point there is still considerable difference of opinion especially when large units are under consideration though it is pretty generally conceded that for small motors the only type that can be considered is the induction motor. Its simplicity, the ease with which it can be started and stopped and its comparative freedom from the annoying troubles that beset its rivals make it an ideal machine to put into the hands of a customer. There is practically nothing to do except to see that the bearings are properly oiled and even this necessitates in many cases almost no attention as these motors sometimes run for a month without even requiring oil. Dust and dirt have very little effect providing the oil in the bearings is

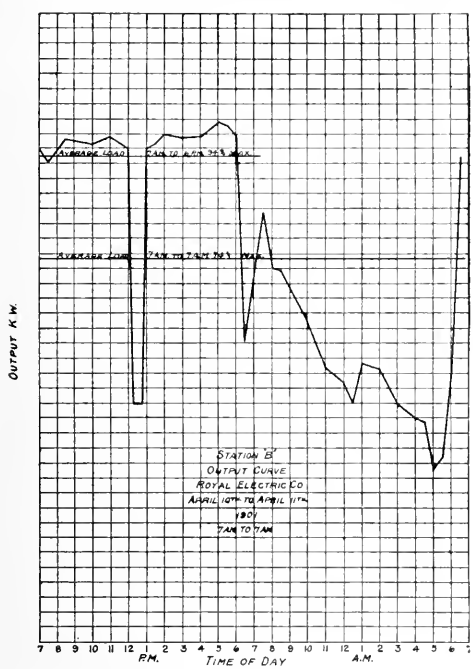



FIG 6

changed frequently, the motor can be mounted on the wall or ceiling almost as easily as on the floor and no extra wiring is necessary if the starting devices have to be placed some distance from the motor. Heavy loads have not the same power to injure it as with other motors as if overloaded too much it merely stops and load must be removed before it will start again. As the motor may remain connected to the mains for several minutes without heating sufficiently to injure it there is no great danger in this proceeding though it is not well to make a practice of doing it. Such a thing as a burned out motor of this type is almost unknown. I cannot recall a single instance where the trouble was due to heating of the conductors unaccompanied by some other predisposing cause. It is true that with rotors of the wound type shortcircuits and grounds sometimes occur though rarely, and these can generally be traced to some defect in manufacture. With rotors of the squirrel cage type the connection of the bars to the end rings sometimes gives trouble but this is likewise generally due to some mechanical defect and motors which have operated for some time without trouble can generally be depended upon to continue to do so indefinitely. The simplicity of the starting devices and their immunity from trouble add much to the reliability of the machine especially when in the hands of inexperienced operators as is usually the case. Induction motors operating continuously for three or four years without a case of trouble are not unusual and this when in the hands of operators who probably never saw a motor before their's was installed.

Even in large units the induction motor has advantages which cannot be gainsaid, both from the point of view of the supply company and of the customer. The principal disadvantage under which it labors is the fact that its power factor is inherently comparatively low. That is that under full load or a little overload the power factor rarely exceeds 94 and few manufacturers will guarantee that figure. The synchronous motor on the other hand can readily be operated at a power factor of unity. If the motor load is of considerable magnitude this makes a very material difference to the operating station as the effect of a large amount of load even with a power factor as high as 94 is to increase the field current of the generators very decidedly. If they are of modern construction and have good regulation on low power factor loads they may be able to deliver full load current without exceeding the limits of field current, but even in this case the output of the station is lowered as the power is generally sold on a basis of true energy and not of volt-amperes. To offset as far as possible this inherent disadvantage these motors should be operated at very high load, that is high compared with what other types of motor should be operated at. If the load is comparatively steady it should be so arranged as to be just about full load for the motor, and if variable it should not be if possible allowed to drop below half load. If the periods of variation are short the motor as a rule will not suffer if the load rises to 50 or 60 per cent. overload. If under these conditions the load as measured by integrating wattmeter for the day does not exceed the capacity of the motor as a rule it will sustain no injury.

The fact that these motors do not run synchronously with the generators is a great advantage to the station in times of trouble on the lines. The only effect that heavy short circuits on the lines have on these motors is to cause them to slow down and on sudden removal of the short circuit the extra power required to accelerate their speed and bring it back to normal prevents the too rapid rise of voltage caused by the falling off in load with the valves or gates wide open, which rises are a fruitful cause of increase in the lamp renewal account. An induction motor also acts as a sort of regulator on the lines, by absorbing more power from the phase with the high voltage thus tending to lower it to equality with the others. Changes of load on induction motors have also less effect on the regulation of the system than they would have with a synchronous motor since the lowering of the load lowers the power factor thus reacting on the generator field and preventing somewhat the rise of voltage which accompanies a reduction of load. A great drawback from a lighting point of view to the use of induction motors lies in the fact that to start they require anywhere from one hundred to two hundred per cent. of full load current. This may be overcome by equipping the machine with a starting motor to get it up to speed before throwing it on the mains but this adds to the complication of the machine so greatly that it has seldom been done, although it should be more generally insisted upon. Where the motor is used to operate direct current generators the trouble may be overcome by starting the motor from the direct current side and throwing it on to the mains when at full speed.

The synchronous motor while possessing a great many advantages has also some points to which objection can be taken. The attendant can by varying the exciting current alter the voltage of the lines to such an extent as to seriously interfere with the regulation, especially if the motor be of large capacity as is often the case. Again any violent disturbance on the line is likely to pull a heavily loaded synchronous motor out of step and with motors of low self induction such as are necessary this makes a particularly vicious short circuit. If there is any large amount of load driven by motors of this type the effect of a heavy short circuit would be to pull them all out of step thus holding down the voltage. The removal of the short circuit together with this large amount of load at the same time would permit the voltage of the generators to rise very considerably and would usually be accompanied by disastrous effects on any lamps that might be burning on the circuits. In the case of large mills or other customers to whom continuity of service means much, this disadvantage should be carefully considered as the starting of a large number of synchronous motors occupies considerable time and the loss caused by the delay is sometimes worthy of consideration, not to speak of the fact that goods in process of manufacture are sometimes spoiled by the delay.

The principal advantage of the synchronous motor lies in the fact that its power factor is under the control of the operator, who, by raising or lowering the exciting current can make the current leading or lagging at will, and by properly adjusting it can operate the motor with a power factor of unity. The fact that by over exciting synchronous motors lagging currents due to induction motors or arc lamps can be compensated for is of the utmost importance. If these motors are so placed that

they are under the control of the station staff, they become valuable means of increasing the output of the station. In plants where there are motor driven arc machines or other machinery which under ordinary conditions is not in use during the day, it is advisable to have the motors of the synchronous type, as in this case they re oper ated all day as condensers supplying to the line the leading current necessary to balance the lagging component due to the inductive load. Properly designed motors operating in this way cause no trouble from pumping, even when over excited, till the armature current is at full load value. These motors, after being used as condensers all day, are operated at night to drive their regular load, as at that time the day load is off and the demand for leading current is not so pressing. In this way the machines do double duty.

In placing synchronous motors on customers premises beyond the control of the station, it is advisable to install some sort of power factor indicator as otherwise an inexperienced or careless operator will rarely have the exciting current at proper value. When it is considered that a reduction in the power factor from unity to 99 per cent. involves an increase of the wattless current to about 14 per cent. of the motor current, it can be understood how important it is that the power factor be kept up. As the exciting current varies for different loads and voltages it is almost impossible in cases where the load is variable to keep the power factor unity, unless the drop in the line exactly balances the regulation of the motor, in which case no adjustment of the field current is necessary for changes in load.

There have recently been several types of power factor indicator devised, but the simplest for two phase systems is an induction wattmeter with its series coil connected in one phase and its shunt coil across the other phase, or across a transformer if it is necessary to reduce the voltage. When connected in this way the meter will run in one direction if the current is lagging and in the other direction if the current is leading, remaining stationary if the power factor is unity. If the meter is properly marked, it is only necessary for the operator to regulate his exciting current as indicated by the disc of the meter. In this way the station can protect itself against the possibility of the regulation being taken out of the hands of the switchboard attendant.

A short explanation of the action of this device may not be out of place for the benefit of those to whom it is not familiar. In an induction wattmeter there are two coils, the series and the shunt, the series having very low and the shunt very high inductance. As a consequence, the current in the shunt coil lags practically 90 degrees behind the voltage, and if the power factor of the system is unity the shunt current lags 90 degrees behind the series current. If now the voltage instead of being derived from the same circuit be derived from the opposite phase, the voltage impressed on the shunt will be 90 degrees displaced from the current in the series, positively or negatively, depending on the direction of rotation of the phases. The current in the shunt will therefore be displaced either 180 degrees from the current in the series or it will coincide with it; in either case there being no torque produced the meter stands still. (See Fig. 3, Diagram 1.) If now the current in the system be made leading, it is evident that the displacement of the current in the shunt with respect to the current in the series coil will be the sum of the angle of lead and 180 degrees, of which 90 degrees may be positive or negative. Suppose the lead to be ten degrees. As the angle 90 degrees may be either positive or negative, the total displacement will be either 10 plus 90 plus 90 equals 190 degrees, or 10 plus 90 minus 90 equals 10 degrees giving a torque proportional to the horizontal component BF in Diagram 2, Fig. 3. Similarly for a lagging current the displacement would be 170, or minus 10 degrees, giving a torque component opposite in direction, though of the same magnitude as in the former case. (See Diagram 3, Fig. 2.)

One of the most important points in selling power is its proper measurement and in order to ensure the proper revenue from each customer the metering devices must be constantly looked after and checked, as otherwise inaccuracies creep in and as these are usually against the supply company the revenue may be seriously impaired.

For metering two phase systems as a rule two wattmeters are used, one being connected in each phase and as the two phases are electrically independent, the readings of the wattmeters when added together give the total power in the circuit. In most lighting systems where the circuits have been carefully laid out the motors will be so nearly balanced that the readings of the meters will be sensibly equal, in which case one meter will answer, the registration being multiplied by two to get the total. It is possible to use amperemeters on motors of this type as the voltage is sensibly constant and if the voltamperes as determined from the meter register and the voltage be corrected by a power factor determined by test the energy may be determined with a fair degree of accuracy.

The energy used by a three phase motor is measured as a rule in one of two ways, one meter and a star box, or two meters. The first method is applicable only to motors that are balanced, as any appreciable difference in the voltage of the phases introduces a considerable error. However, with non-inductive wattmeters and a balanced system this method is very convenient and has the advantage of requiring only one meter. The star box consists of a non-inductive resistance twice as great as the resistance of the shunt coil of the wattmeter. One terminal of the shunt of the meter is connected to the leg in which the series coil is inserted and the other end to the middle point of the star resistance, the two ends of which are connected to the other two legs of the three phase circuit. In this case the total energy in the circuit is three times the reading of the wattmeter.

For unbalanced circuits, which are most common, the two wattmeter method must be used. In this system one wattmeter is connected in each of two legs of the circuit, one end of the shunt coil of each being connected to the same point as the series, and the other ends connected to the third leg of the circuit. The total energy in the circuit will then be the sum of the meter readings, that is, the algebraic sum, as one reading may be negative. The indications of the meters will in most cases not be alike, as this is only the case if the power factor is unity and the circuit is balanced, under other conditions the indication of one meter may be anything from 0 to 100 per cent. of the other. In connecting the meters care must be taken to see that they run in the proper direction to make the sum of the registrations the total energy of the circuit. Having connected the meters temporarily, note the direction in which the meters run with light

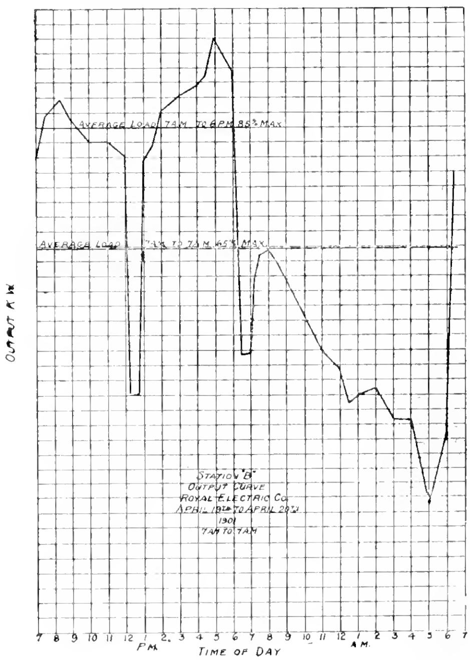



FIG. 8

load on the circuit. If they are both running forwards increase the load on the circuit considerably. If now both meters are still running forward and have increased their speed the connection is correct, while if one meter continues to run forward at increased speed while the other has slowed down or reversed, it indicates that the meter whose rate decreased is connected backwards and should be reversed.

In testing motors, especially those of large size, considerable care must be exercised in order to make the results of the test show accurately the amount of power used. As the load is usually somewhat variable, it is almost impossible to read ordinary indicating instruments with any degree of accuracy. Errors of five and ten per cent. are common even when observers are experienced, and as a result tests made in this way are always open to doubt. To overcome this difficulty as far as possible integrating meters are now largely used to determine the energy delivered to motors of this type. The meter being connected into the circuit in the same manner as an indicating wattmeter, the speed of the moving disc is measured for a period of twenty to thirty seconds and from this and the constant of the meter the watts are deduced. The integrating meter can be checked on perfectly steady load when convenient and the proper correction made. As wattmeters can now be procured whose

variation of rate on loads having different power factors is practically zero, this need not introduce any appreciable error. Complete tests can be much more satisfactorily made in this way than by a comparison of the voltamperes with the true watts. To determine the load and power factor of a two phase motor, proceed as follows: Connect two wattmeters in series in one phase of the circuit. Connect the shunt coil of one across the same phase and the shunt coil of the other across the second phase. With load on the circuit determine the watts indicated by each meter, calling the indication of the meter whose series coil is in phase A, and whose shunt is across A,-X, and the indication of the meter whose series coil is in A and shunt across $B_1$-Y. Then the energy in phase A is indicated by X, and the power factor of phase A is found as follows:

$$P.\,F. = \frac{Y}{\sqrt{K^2 Y^2 + X^2}} \text{ where } K = \frac{\text{Voltage of A}}{\text{Voltage of B}}$$

For indications on meter, X are proportional to voltamperes multiplied by the cosine of the angle of lag, and the indication on wattmeter Y is proportional to the cosine of the angle of lag plus or minus 90 degrees, or equals voltamperes multiplied by the sine of the angle of lag.

Let $V_1$ be voltage of phase A
Let $V_2$ be voltage of phase B
Let $I_1$ be current of phase A
Let $\phi$ be angle of lag
Then $X = V_1 I_1 \cos\phi$
Then $Y = V_2 I_1 \cos\phi$
Then $\frac{V_1}{V_2} = K$
Then $X = K V_2 I_1 \cos\phi$
Then $Y = V_2 I_1 \sin\phi$
Then $\frac{X}{Y} = \frac{K \cos\phi}{\sin\phi}$
Then $\frac{X_2}{Y_2} = \frac{K_2 \cos_2\phi}{1 - \cos_2\phi}$
Then $\cos_2\phi - \frac{X_2}{K_2 Y_2 + X_2}$
Then $\cos\phi = \frac{X}{\sqrt{K_2 Y^2 + X_2}}$

In case the system is balanced.
K = I

$$\cos\phi = \text{Power Factor} = \frac{X}{\sqrt{Y^2 + X^2}}$$

As in most cases it is much more accurate to measure seconds per revolution than revolutions per second, and as a rule the two meters used are of the same capacity and have the same constant, it is sufficient to compare the seconds per revolution instead of the watts, and as seconds per revolution is the reciprocal of revolutions per second the formula will have to be changed. Instead of writing

$$\cos\phi = \frac{X}{\sqrt{K^2Y^2 + X^2}} \text{ we substitute } \cos\phi = \frac{Y}{\sqrt{K^2Y^2 + X^2}} \text{ or for Balaic } \frac{Y}{\sqrt{Y^2 + X^2}}$$

in which X and Y are seconds per revolution of the meters respectively whose watt readings were X and Y.

As an example of the accuracy with which tests can be made by this method when compared with the older volt ampere method, I would draw your attention to the results given in Fig. 4. You will note that the power factor as determined by integrating wattmeter varied only among the five readings by one half of one per cent., while the power factor from the voltamperes and watts by Weston wattmeter varied 2.7 per cent. I might add that the watts from indicated wattmeter is the average of readings of two Weston wattmeters which agreed with each other and were read by two observers. The change in the power factor introduced by altering the exciting current of a synchronous motor was instantly detected by this means while the voltampere method failed to show it. When the conditions were made the same as at first the power factor dropped back to within one-tenth of one per cent. of the average of the first five readings. The application of this method has eliminated practically all the uncertainty that used to attend the testing of synchronous motors and it has been shown that many cases of abnormally high or abnormally low power factor as measured by indicating wattmeter were simply the result of inaccurate readings and that when this method was substituted the results obtained were quite normal, and tests made under different conditions and at different times could be intelligently compared.

In testing three phase motors, whether balanced or unbalanced, providing, as is usually the case that the position of the voltage of the three phases is known, and that the curves are approximately sine curves, the power factor can be determined from the wattmeter readings only when connected in the two wattmeter system.

For let the first current be I, and the first voltage V, it is desired to find the lag $\phi$ of the current behind the voltage.

Let $V_2 = K V_1$ when K is known constant. Let $V_1$ lead $V_2$ by known angle. Let indication of wattmeter with current I and voltage $V_1$ be $W_1$, and indication of wattmeter with current I and Voltage $V_2$ be $W_2$.

$$P\,F = \frac{W}{V\,I} = \cos\phi$$

$$W = V\,I \cos\phi$$

$$W_1 = V_1 I_1 \cos\phi$$

$$W_2 = V_2 I_1 \cos(\phi - \alpha) = K V_1 \cos(\phi - \alpha)$$

If ratio of wattmeter reading is R:

$$R = \frac{W_2}{W_1} = \frac{K V_1 I_1 \cos(\phi - \alpha)}{V_1 I_1 \cos\phi}$$

$$\frac{R}{K} = \cos\alpha + \sin\alpha \tan\phi$$

$$\tan\phi = \frac{R}{K \sin\alpha} - \cot\alpha$$

In a three-phase system using voltage A B as $V_1$ and A C as $V_2$:

$$\tan\phi = \left(\frac{R}{\sin 60} - \cot 60^\circ\right) = \frac{2R}{\sqrt{3}} - \frac{1}{\sqrt{3}}$$

As it is usually desirable to obtain the angle of lag of the current in A with respect to voltage half way between AB & AC, This equation for balanced loads becomes:

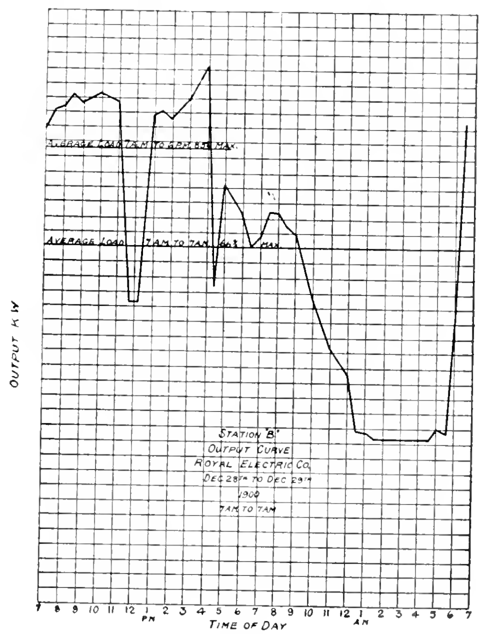



FIG. 7

$$\frac{W_1}{W_2} = \frac{\cos(30 - \phi)}{\cos(30 + \phi)} \text{ from which}$$

$$\text{Tan } \phi = \sqrt{3}\frac{W_1 - W_2}{W_1 + W_2} = \sqrt{3}\frac{1 - R}{1 + R}$$

For values of lag such as are common, between 0 and 60 this approximates

$$\phi = 60^\circ - \frac{60}{R}$$

The variation of power factor, with variation in the ratio of these meter readings, is very well shown graphically in Fig. 5, which method was originated by Mr. Frankenfield. In this diagram the two curves

$W_1$ and $W_2$ are plotted from the equations
$W_1 = V_1 I_1 \cos(30 - \phi)$
$W_2 = V_2 I_1 \cos(30 + \phi)$

The upper curve of ratios is plotted from the ratio of the magnitude of the ordinates of the two curves immediately below. To obtain the power factor, having the two wattmeter readings, divide one of the readings by the other, in such a way that the ratio will be less than 1. Ascertain whether the angle of lag is greater or less than 60 degrees, which can usually be determined by inspection, but if not it can be determined by increasing the load on the motor, when, if both indications increase, the angle of lag is less than 60 degrees, while if one indication increases and the

other decreases, the angle will be greater than 60 degrees. Select a point on the vertical scale of the upper curve, corresponding to the ratio found, and from this point draw a horizontal line, intersecting the curve, and from this point drop a vertical line on the power factor curve below, the point on the vertical scale opposite will be the power factor, and the point on the horizontal scale will be the angle of lag or lead. This method is applicable only to balanced circuits in which the voltage and power factor of the phases are equal.

As an example of what may be accomplished along the line of increased load factor in a comparatively short time if the problem is consistently and earnestly grappled with, let me draw your attention to the curves shown in Figs. 1, 2, 6, 7, 8.

In Fig. No. 1 is plotted the load curve of the Royal Electric Company's Station B, for July 30th and 31st, 1897, this being consequently the light summer load. In Fig. 2 is shown the load for Dec. 21st and 22nd of the same year. At this time there were no alternating current motors in operation, and the load represented is exclusively lighting. Under these conditions the load factor was 54 per cent. for summer and 43 per cent for winter. In Figs. 6, 7 and 8, is shown the effect of adding day load. Instead of operating all day under a load about half of the maximum evening demand, we find that the average load in Fig. 6 is actually 21 per cent. greater than what should be the peak. In Fig. 7 we have a maximum power load, 30 per cent. greater than the lighting peak, and this is the heaviest season for lighting. In Fig. 8 we have the almost unhoped for condition of an average load for the twenty-four hours greater than the maximum lighting peak. In Fig. 8 we have exactly the same power load as in Fig. 7, but there is added to it considerable lighting load, as the day was very dark and the effect of the business lighting coming on about four or five o'clock can be clearly seen. In Fig. 6 is shown very clearly the effect of the limited service contracts, as exactly at four o'clock the power load falls off, leaving the lines clear for the lighting, which reaches a maximum about an hour later and then falls steadily off, till about half past six, when a second lighting peak caused by residence lighting occurs. This steadily drops from about eight o'clock until at midnight, all the load with the exception of the all-night service, is off the lines.

Within a comparatively few years the possibility of a lighting station operating a load actually heavier during the light part of the day in summer than during the dark hours of the afternoon in winter would have been considered so improbable that it would have received scant consideration, but you have before you curves showing that this apparently paradoxical condition has been reached, and I think I may safely say that the conditions illustrated by the curves before you are as interesting and remarkable, as I believe they are unprecedented.

## Notes on the Construction and Protection of Aerial Transmission and Distribution Systems.

By K. B. Thornton, Montreal.

In this country the majority of Transmission and Distribution Systems are of overhead construction, and are likely to remain so for many a long day. As these systems are exposed to all kinds of weather it is a matter of great importance to those who are operating the same that they be constructed and protected in the best possible manner. Aerial lines are constructed by placing wooden or iron poles in the ground generally at distances varying from 105 to 120 ft. apart in cities, and from 90 to 100 ft. apart for high voltage transmission lines in the country.

For wooden poles, cedar wood, owing to its lasting qualities is generally used up to lengths of 50 or 55 ft.; beyond this length they are hard to get of suitable proportions, the tops being often too small and the butts too large, and the price prohibitive. Apart from this cedar is also too brittle a wood to use for high lines. Spruce and pine poles are therefore used where lengths over 55 ft. are required, chestnut and other desirable woods not being obtainable in this country. As it is daily becoming harder to get long poles it is often necessary to resort to splicing poles to get the proper lengths.

Good cedar poles will last for twenty years and more without showing any signs of rotting but red pine poles will generally rot at the butt in cities in less than ten years, and spruce poles often show signs of rotting in four or five years, depending very much, however, on the nature of the ground in which the pole is located.

With a view to increasing the life of spruce and pine poles it is customary when placing them to coat the butts with a heavy coating of tar. The length of poles is governed by the conditions of locations. They are usually from 40 to 65 ft., and to clear high buildings, from 75 to 80 ft. Experience has shown that it is advisable to keep the lengths of the poles as short as possible, as they are less exposed to the weather, and it is generally a hard matter in Cities to guy them.

Throughout residental and suburban districts and for transmission lines through the country the usual length for poles is 40 ft. The following are some of the essential features of a pole contract:

Poles to be of good, sound, well shaped line cedar wood, not less than seven inches in diameter at the small end.

Poles to be cut square at both ends and the bark stripped off clear from the top to within six feet from the butt, and all knots to be neatly trimmed off; no pole will be accepted with two curves in it.

Poles will be inspected and branded at point of shipment, the inspector having the power to reject any pole that he may consider to be unsatisfactory.

Shaving Poles.—Poles when unloaded at the pole yard are inspected and shaved, the cost of shaving averaging about ¾ cent per foot.

Setting Poles.—In regard to the setting of poles no regular rule can be given for the depth which they should be set in the ground; usually it is from 5 to 7 ft., depending on the height, location and the condition of the ground in which they are located.

The following are the usual depths of setting in good ground;

| Height of Pole. | Depth of Setting. |
|---|---|
| 35 to 45 ft. | 5 ft. |
| 50 to 55 ft. | 6 ft. |
| 60 to 80 ft. | 7 ft. |

In marshy or "made" ground it is often necessary to concrete the butts of poles, using a mixture composed of one part of cement, three parts of sand and five parts of broken stone.

Up to a height of 45 ft. poles are set with pike poles and a dead man, and over that height with a derrick.

The number of men being as follows:

| Height of Pole. | No of men required. |
|---|---|
| 30 ft. | 6 with pike poles. |
| 40 ft. | 7 with pike poles. |
| 60 ft. | 10 with derrick. |
| 70 ft. | 15 with derrick. |
| 80 ft. | 15 with derrick. |

Should the poles be wet one or two additional men may be required on account of the extra weight. The gains are cut while the pole is on the ground and also when used in Cities the holes drilled for spikes.

When a pole is once set the earth is well tamped round the butt; this is especially necessary in the early Spring when the frost is not quite out of the ground, and if not properly attended to, the poles will get out of line in a very short time.

Spikes are of square wrought iron, 9 in. x 9-16 in—two men being able to drive about 500 per day of ten hours, once the holes are bored.

Cross Arms are usually of red or yellow pine and vary in length for ordinary city service from 2 ft. 6 in. for a two pin arm, about 8 ft. for a six pin arm, and have a sectional area of 3¼ x 4 ¼ in. for all ordinary work; for transmission lines the dimensions will vary from the above depending on the nature of the transmission service.

Cross arms are rounded or chamfered on the top side to prevent water gathering and lag screwed to the poles with 7 in. x ½ in. lag screws. Some prefer to fasten the cross arm with bolts passing through the poles, but our experience has been that it is easier to replace cross arms that have been lag screwed than those which have been bolted, as the bolts generally rust, making it necessary to use a drift to drive them out.

Braces.—All four and six pin arms should be braced with flat iron braces not less than 1¼ in. x ¼ x 27 in., bolted to the cross arm by 4 in. x ⅜ in. machine bolts at one end and either lag screwed to the pole with a 4 in. x ⅜ in. lag screw, or bolted to the next cross arm underneath.

On important transmission lines with long and heavy cross arms, where very strong work is required, braces of angle-iron in one piece are sometimes used.

A brace composed of one piece has some distinct advantages, for instance, some time ago one of the wires on a high voltage transmission line slipped off the insulator on to the cross arm, and the current to ground through the pole burned the cross arm

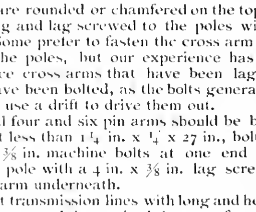


Fig. 1

clean off the pole, leaving the two outside ends of the arm supported by the brace, permitting the service to remain uninterrupted until such time as the line could be conveniently shut down.

Pins are fitted in holes drilled in the cross arms about 15 in. apart and 22 in. between the centre two pins, and secured by a wire nail driven through the cross arm.

After considerable experience with oak pins they have been abandoned in favour of 1½ in. locust wood pins, it being found that oak pins after five or six years were inclined to rot and break off at the shoulder when subjected to any great strain.

Where great strength is required at corner poles or for dead ending, it is advisable to use solid iron pins.

On long straight runs it is advisable to set the cross arms in such a way that they alternately face each other on adjacent poles and are back to back on the next two poles; in this way, should a stretch be cut down or a pole break, there is less danger

of the cross arms being wrenched off than it they were all set in the one direction.

At all long stretches, corners, and for dead ending, cross arms should be doubled, with a spacing block at either end of same and fastened at the ends by bolts run through the spacing blocks.

INSULATORS.—For regular line voltages of 2000 to 3000 volts, the ordinary deep grooved, double petticoat glass insulators are used; for higher voltages it is necessary to use specially prepared triple petticoat insulators of porcelain or a combination of porcelain and glass, so proportioned as to give the greatest distance between the point of support of the wire and contact with the pin and at the same time permitting of a minimum amount of surface leakage.

These insulators are ordinarily subjected to a break down test before being placed, in order to locate defects.

WIRE.—For all ordinary line work soft drawn copper wire is preferable to hard drawn, the disadvantages, in using it due to increase of sag being more than offset by the difficulties in handling hard drawn wire and the possibilities of damaging same when it is being erected.

As yet aluminum has not come into general use for overhead construction owing to the difficulty of making proper joints and the greater size of the conductor necessary to get the equivalent conductively of copper.

It is customary on city lines to use wire insulated with a double braid of cotton thoroughly saturated with an insulating compound.

Rubber covered wires for line work are of no use as the insulation will deteriorate in a comparatively short time, when exposed to all kinds of weather, rendering it worse than useless.

TIEING.—The line wire is secured to an insulator at each cross arm, being laid in the groove of the insulator and tied with a short length of wire about one or two guages smaller than the line wire.

JOINTING.—The ordinary twist joint is used except on very heavy wires of No. 000 guage and over, when it is better to use a lap joint as it runs over the cross arms easier when the wire is being strung.

DEAD ENDING.—Lines are generally dead en ed, on double cross arms, the wire being twisted round the insulators and then back on itself, and the tie wires soldered to the line wire on the last two or three poles. (Fig. 1.)

For high voltage lines, a dead ending arrangement, consisting of a series of globe strain insulators is sometimes used, the line

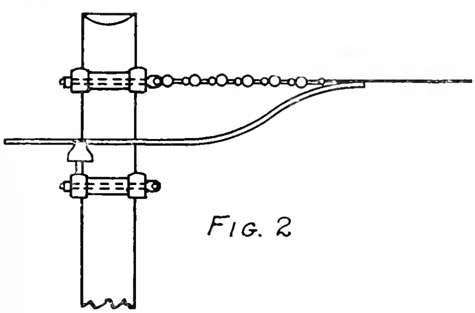


FIG. 2

being fastened to one end of a string of strain insulators, the other end of which is bolted through the cross-arm as shown in Fig. 2.

This system of dead ending is not altogether satisfactory as the insulation of the strain insulators deteriorates and breaks down.

Fig. 3 shows another method for dead ending high voltage lines, which has proved to be very satisfactory, although more expensive than that shown in Fig. 1.

With this arrangement the wire is tied round two insulators, supported on a special iron bracket which is bolted through the cross-arm, the centre of the wire being in line with the shank of the bracket.

STRINGING WIRE.—Wire when strung is subjected to mechanical strains due to weight, tension, variations in temperature and additional weight in winter due to ice, and when stringing wire in our Canadian climate, special allowance must be made for variations in temperature.

Dynamometers are not ordinarily used to determine the tension of the wire strung, but experience has shown what sags to allow between poles for different sizes of wire.

The deflection of a wire supported between two points is given by the formula :

$$d = \frac{L^2\ W}{8\ T}$$

Where d = Vertical deflection at middle of span.
L = Length of span.
W = Weight of wire in lbs. per ft.
T = Maximum tension of wire in lbs.

The length of a wire in a span is given by the formula :—

$$L_1 = \frac{L + 8\,d^2}{3\ L}$$

Where $L_1$ = length of wire and L = length of span

$$\text{or } d = \sqrt{\frac{3\ L\ (L_1 - L)}{8}}$$

STRESSES. Pole lines are subjected to various stresses which have all to be provided for.

These stresses are firstly, those due to the weight of the conductors and fixtures on pole, or the weight of ice on the conductors together with their weight tending to crush the pole, and secondly, those due to the lateral pressure of the wind on the pole and conductors, tending to break the pole by bending ; the action of the wind also has the tendency to break the pole near the ground due to vibration.

The danger due to crushing is not very great as there is always a very large factor of safety.

On one of the heaviest pole lines in Montreal the factor of safety for crushing under ordinary conditions is about 400. Once during the winter, after a very heavy sleet storm, this factor was reduced to about 240, owing to the extra weight of ice on the wires.

The stresses, however, which are most to be feared, are those caused by wind.

The same pole line mentioned was blown down in November last during a hurricane, about eighteen 70 ft. poles being broken.

McGill Observatory reports gave the velocity of the wind at 75 miles per hour which is equivalent to a pressure of 25 lbs. per sq. ft. This represented a total pressure on each stretch of this particular line, of 3,750 lbs., and there is no doubt if this had been applied as a constant pressure, that the poles and guys would have withstood same. However, the combination of the

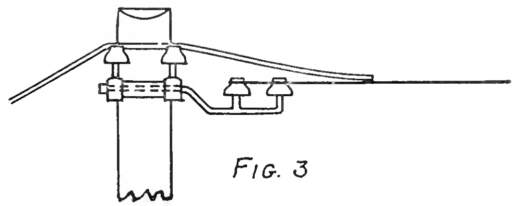


FIG. 3

DEAD-ENDING LINES

wind and the swinging of the wires evidently produced a strain in excess of the strength of the poles and guys.

GUYING.—All lines require lateral support in the shape of braces or guys to withstand wind stresses, the poles themselves when loaded with wires being unable to withstand same.

In the country, poles can be side braced with short wooden poles or guyed with anchor rods, but in cities this is impossible and guy wires have to be used.

Galvanized iron or stranded steel is used for guy work, the stranded steel being preferable as it is much more flexible and its weight length for length considerably less.

On long, heavy lines, poles in addition to being side guyed, should be guyed with crossed head guys every four or five stretches to prevent the line running back or the poles breaking, should any single pole in the line break or a stretch be cut or broken down.

Where there are several cross-arms on a pole the "Y" guy is most useful, and at points where circuits dead end on one side of a cross-arm "Y" guys should also be used to prevent the arms being twisted out of line.

The practice of guying to trees and buildings should be avoided in all cases, for aside from making poor anchors for guys, they are subject to removal at a minute's notice from the proprietor and the company owning them is also liable for damages.

LIGHTNING PROTECTION.—The protection of aerial lines from the effects of lightning storms, is a matter which has received considerable attention from all central station engineers operating overhead systems.

With the advent of high tension transmission lines, the difficulty of effectively protecting same has been greatly increased.

Over-head systems may be affected in the three following ways :

(1) By direct strokes.
(2) By induced discharges.
(3) By electrostatic induction.

Fortunately for electric installations, direct strokes do not frequently occur for probably no arrester would be of much service in preventing such a discharge from doing considerable damage.

Induced discharges following a lightning flash and static charges, due to surrounding atmosphere being charged, are the conditions which have to be specially provided against.

Owing to the high frequency of lightning discharges any inductance on the line offers an enormous impedence to a discharge, which fact accounts for the [illegible] turing of transformer coils, the discharge taking the shortes[illegible] most direct path to ground.

Arresters are non-inductive [illegible] stances usually air gaps, one side being connected to the line and the other to earth, the resistance of these gaps being low enough for the lightning to choose same for a path to ground rather than through some of the apparatus connected to the lines.

The length of the gap is governed by the working voltage of the line, the general practice of the day being to make it as small as possible without the ordinary current jumping across. However, this has the disadvantage that arresters are apt to be too sensitive and cause trouble due to dust, cobwebs and dirt accumulating, or the fusing over of the spark gaps due to repeated discharges, thereby causing a short circuit on the line or

a heavy ground as the dynamo current follows the lightning discharge across the gap.

A lightning arrester, in addition to affording a short path to ground, must also perform the duty of an arc breaking circuit breaker to immediately interrupt the flow of the line current to ground and extinguish the arc which is formed.

Owing to the fact that any inductance in the line offers considerable resistance to the passage of a lightning discharge, choke coils are sometimes introduced in series with the line, between the arrester and the central station, the combination of arresters and choke coils forming a very reliable means of protecting the apparatus in the station.

It is not a general practice to install a choke coil in conjunction with every arrester placed on the line, owing to the high cost which would be involved; however, it is a good scheme to place such a combination to protect any large and expensive apparatus connected to the circuits.

These choke coils are usually constructed of flat copper strip wound on a non-conducting core, the layers being insulated with mica or some other insulator.

Any self induction in the way of coils or turns in the ground wire of an arrester must be avoided and when they are being put up, the linemen should be watched, as it is a favorite trick to take up any slack in a wire by making a little coil ; any such coils would be nothing more or less than choke coils which would completely offset the value of the arrester, rendering it virtually useless.

The ground wire is a most important feature in the installation of a lightning arrester and there is no doubt that many failures of arresters to protect lines are due to poor ground connections.

To effectively protect a circuit, arresters should be placed at the end of all lines and at points where they branch off in different directions and they should be inspected and cleaned from time to time.

Despite the many devices used on the various types of arresters to extinguish the arc formed, the line current is occasionally not broken, thereby causing a short circuit or dead ground. To avoid this fuses are sometimes placed on the ground wire of single pole arresters and in both leads of double pole arresters ; this however makes it specially necessary that an inspection be made after every storm so that should any fuse be blown it can be replaced before the next storm.

Barb Wire.—Owing to the somewhat uncertain action on lightning arresters barb wire has been used on transmission lines as a protection against lightning, and the results obtained have clearly demonstrated that it is a most satisfactory means of protection.

Barb wire is usually strung on pins on top of the poles and also at the ends of top cross-arm. In some places a special two pin cross-arm has been used above the line wires, to carry the barb wires, and in other places a single line of barb wire is strung on top of the pole.

Experience has shown that it is advisable to fasten the barb wire to glass insulators on pins rather than to staple it to the pole owing to the superior mechanical support, the insulator of course not being used for insulating purposes.

Some engineers consider that the trouble caused by using barb wire offsets its value as a protective device ; and for that reason its use has been abandoned in one or two instances.

A description of the methods adopted to protect the Chambly 12,000 volt transmission lines from lightning may be of interest as the results obtained on the two lines have been eminently satisfactory.

Two duplicate lines are run from Chambly to Montreal, the total distance being about 17 miles for each line, of which 14½ miles are aerial and 2¼ miles underground cables. The underground cable is divided up in three sections, the first section being about a mile and a half from the power house, the second about fifteen miles from the power house, and the third at the Montreal end.

The country through which the lines pass is very flat and marshy towards the Montreal end. Three lines of barb wire on glass insulators are run on each pole line as shown in Fig. 4, two lines being run on the ends of the top cross-arm about fifteen inches from the line wire and the third on a pin on top of the pole.

The barb wire is composed of two twisted No. 12 B.W.G. galvanized iron wires with one four point barb every five inches, and is connected at each pole by means of a soldered joint to the ground wire. This ground wire is stapled down the face of the pole and is twisted several times round the butt, after running through an iron pipe about eight feet long, which projects above the level of the ground, preventing the wire from being cut or broken, as well as affording an additional ground.

The ground wire and pipe were stapled on the pole when the poles were being erected.

As the poles on the transmission lines are set ninety feet apart the barb wire lines are grounded about fifty-eight times per mile; this frequent grounding being one of the most important points in the protection.

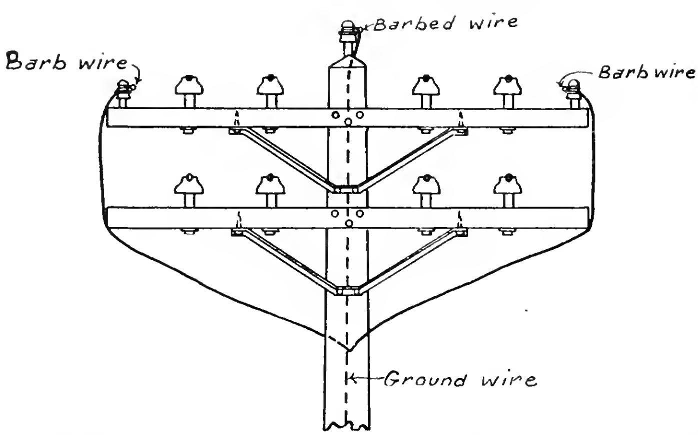
It was the intention before putting the lines into use, to place lightning arresters in addition to the barb wire, but as they were not available in time the lines were put into operation without them.

Our experience with the first series of storms showed that well grounded barb wire was a very effective protection, and the lines were therefore operated under these conditions for one entire summer.

Recently arresters of the air gap type have been installed at the power house at Richelieu as additional protection.

During one particularly severe storm the local distribution lines in Montreal and Chambly, which were not protected by barb wire, were considerably affected, while no effects were felt on the transmission lines at all, although trees were struck in its immediate neighborhood.

It was at first thought that the barb wire would rust and break down very quickly, but after two years operation an inspection shows that it is in a very good condition, and as yet there has never been a single case of it breaking.




## SOCIAL FEATURES.

The social features announced on the programme were all carried out on time, and afforded much instruction as well as enjoyment to the visitors. The showers of rain which fell at intervals during the convention, came so opportunely as not to interfere with the carrying out of the programme.

At the close of the business proceedings on the first day, a carriage drive was provided by the citizens, enabling the visitors to view to advantage the many features of interest in and about the city. In the evening by the courtesy of the Ottawa Electric Co., a visit was made to Brittania-on-the-Bay, a delightful summer resort about eight miles distant from the city, where music was provided by the local Regimental Band.

At noon on Thursday a group photograph of the members was taken on the steps of the Parliament Buildings. At the close of the afternoon business session, the Ottawa Fire Brigade gave an interesting exhibition of their modern fire-fighting appliances, and the promptitude and skill of the firemen in the use of the same. At 9 p.m. upwarps of one hundred members and invited guests of the Association assembled in the dining hall of the Russell House, to participate in the Annual Association Banquet. The function, which was presided over by the President, Mr. A. A. Dion, was a most successful and enjoyable one. The toast list was as follows :—"The King," to which the company

heartily responded by singing the National Anthem; "Our Guests," responded to by His Worship, Mayor Morris, and Mr. Warren Y. Soper; "Kindred Associations," to which Mr. Fred. Nicholls responded on behalf of the National Electric Light Association; Mr. Thos. Ahearn, for the American Institute of Electrical Engineers, and Col. Anderson for the Canadian Society of Civil Engineers; "The Press" and "The Ladies." A choice programme of instrumental music was rendered during the evening by the Orchestra of the Governor General's Foot Guards, and some capital songs were sung by Messrs. Frank Buels, J. E. Miller, and Chas. Watt.

On Friday afternoon, after the close of the last business session of the convention, visits were made to the power houses and other points of interest at the Chaudiere, and afterwards by courtesy of the Hull Electric Co. to Queen's Park, Aylmer, and to the power houses of the Hull Electric Co., and the Capital Power Co. at Deschenes Rapids. While at Aylmer a cordial vote of thanks to the Local Committee for their untiring and successful efforts to insure a pleasant time to the visitors was passed on motion by Mr. E. D. McCormack.

## CONVENTION NOTES.

"You're no better than nobody else" was the retort flung back by a French Canadian hack-driver at a confrere who objected to to being "backed into" by the man in front, during the carriage drive. To an enquiry as to where he was going, the same individual replied, "I can't help it; I hev to follow the fellow behin; don' I?"

The tendency to substitute very large for small units is well exemplified in the new generating stations at Ottawa and Deschene. The simplicity of these stations is in striking contrast to the complexity of those of an earlier period.

The visitor is impressed with the fact that current is being cheaply produced in Ottawa by seeing electric lights burning in shop windows at almost all hours. The flat rate consumer evidently believes in getting his money's worth.

One of the beautiful sights was the glowing line of incandescent lamps which light the tracks of the Ottawa Street Railway Company's line to Brittania on the Bay a beautiful pleasure resort which the Company has established eight miles distant from the city. Every other pole on this line carries an incandescent lamp. The delegates were carried over the line at the speed of a mile in two minutes.

Mr. J. A. Burns, of Montreal, had his pockets filled with steel paper knives with bone handles on which was displayed the name of Munderloh & Co., Montreal, dealers in electrical supplies. There was a large demand for this useful souvenir.

Mr. E. E. Carry on behalf of Messrs R. E. T. Pringle, presented the delegates with a useful souvenir in the form of a pocket measuring tape the case of which bore the name and address of the donors.

Mr. Frederic Nichols, has forwarded a cheque for $20 to the chief of the Ottawa fire department in token of his appreciation of the creditable exhibition afforded the visitors of the efficiency of the brigade.

Mr. Geo. Sadler, of Lindsay, was one of the verterans of the convention, and appeared to thoroughly enjoy himself.

## MR. P. G. GOSSLER.

Mr. Gossler, the newly elected President of the Canadian Electrical Association, was born in August 1870, at Lancaster, in Columbia County, Pennsylvania. In 1890, when not quite twenty years of age, he graduated from the Pennsylvania State University as Mechanical and Electrical Engineer.

After a short service with the Chester Foundry and Machine Co., of Chester, Pennsylvania, and with the Edison Electrical Company, at their New York Office, he joined, in April, 1891, the staff of the United Electric Light & Power Company, operating several lighting stations in New York City, and remained with that company as Electrical Engineer, until about May, 1895, when he came to Moutreal to take the position which he now holds of General Superintendent and Electrical when he came to Montreal to take the position which he now holds of General Superintendent and Electrical Engineer of the Royal Electric Company.

His experience with these two companies has been very varied and extensive. While connected with the United Electric Light & Power Company, of New York City, he designed and constructed the extensive distributing switchboards for handling the large business in incandescent lighting, and was also actively connected with and engaged in the placing of the underground cable system of that company, covering the city up to 125th street.

His work with The Royal Electric Company has, as is well known, been of the most extensive and varied

MR. P. G. GOSSLER,
President Canadian Electrical Association.

character, including the re-arrangement of all the distributing circuits, the re-construction of the generating plant, and the extension of its system from a service of less than 50,000 lights to upwards of 115,000 lights and some 10,000 horse-power for motor service, together with the extensive system of street lighting service. He is also very actively engaged in and has supervision of the works at Chambly, and their operation at the power house and in Montreal is entirely under his direction.

He has kept himself fully in the forefront of practical electrical work as applied to lighting and power service. He is a member of the American Institute of Electrical Engineers, and is recognized as an authority in electrical as well as mechanical and hydraulic work.

Immediately on his arrival in Canada Mr. Gossler connected himself with and took an active interest in the Canadian Electrical Association. His abilities were at once recognized, and he was appointed a member of the Executive and other important Committees. In appreciation of his valuable services, he was elected first vice-president and at the recent convention in Ottawa, was accorded the highest position in the gift of the Association. There exists the utmost confidence that during his term of office, as president, he will adorn the position, and promote in the highest possible degree the interests of the Association.

## ACCIDENTS TO RESERVOIR DAMS.

By C. Baillarge, Mem. Am. Soc. C. E.

The late washout at the reservoir dam at Middlefield, Mass., and that at Chicoutimi, Que., can only avail as lessons in "The Instructiveness of failure" when the way in which they occurred can be made known to the profession.

True, it has been shown that in the Middlefield case, where the dam was but 20 feet high, and the level of the spill-way 15 feet, the gates over the spill-way could not be opened due to their faulty construction and that the water rose till it poured over the dam and caused its destruction; but how the erosion could have caused the wreck is not explained, in view of the fact that between the outer walls of the dam which was 30 feet in breadth and abundantly heavy and strong to resist any pushing or forcing of the dam forward as at Boazey in France, Austin in the United States and elsewhere, there were two intermediate bulk heads or walls of 2-inch matched sheet piling on boarding.

No gradual erosion from the top downwards could therefore have occurred on account of these intervening water tight partitions. The only way then of explaining the washout through and through the dam, is this: the overflowing water, first wore away the outer, lower or down stream of the three vertical sections of earth work into which the dam was divided by the bulk heads, taking with it the rubble work of the revetment wall, the component stones from which were found as far as 500 feet down the river.

When this outer or lower portion of the dam had crumbled away, the lower of the two bulk heads followed suit, after which the over-pour of water immediately attacked and scoured away the middle section of the earth work, followed by the overthrow of the upper or inner bulk head, and this by the immediate cutting through and down, by erosion, of the inner or up-stream section of the earth filling with its protective wall of dry rubble.

Where a portion of the clay filling was resistent enough to hold its own against the scour, up to a certain height from bottom level of reservoir, the portions of the bulk heads above that level, were of course broken off at level of top of remaining clay by the direct pressure of the water behind them.

The Middlefield mishap is therefore a case not of the bursting of a dam, not of a bodily pushing away of the dam as at Austin, but one where the dam failed, as do the levees along the Mississippi, by erosion of the water from above downwards.

We shall now see that the accident at Chicoutimi is a case of erosion from below upwards. The dam across the Chicoutimi, which is one of the out-flows or discharges from Lake Kinogami and its smaller companion as expressed by the diminutive "Schish" Kenogamischish, is about a mile from the city or town of Chicoutimi, the Metropolis of the Saguenay District.

The dam is built at right angles across the stream, a powerful one emptying into the Saguenay river. It is a wooden structure of crib work with a base up stream of about 3 to 1, planked over with a water tight flooring and relying for its stability on being kept down and in situ by the very weight of water above it, some 20 feet higher than on the down side, and though, the higher the water within the reservoir the greater the thrust outward or downward, the greater also the weight upon the dam and its adherence to the bottom on which it rests and is probably bolted to.

Above the dam proper is a superstructure some 10 feet or more in height answering as a bridge or roadway between the opposite sides of the river and to the upper or up stream side of this superstructure are adapted a series of some 20 gates or more, but which as at Middlefield, must have been inoperative due to their great size under a head of some 10 feet of water against them: for the water on the occasion of the accident about to be related rose to 10 feet above its normal freshet level and evidenely pressed hard against the dam superstructure which is entirely too narrow, it being but 12 feet wide instead of 20 which it should have been; and to proof, it is now bulged down stream, wriggled and out of plumb as well as out of line.

Now while this dam of some hundreds of feet in extent across the river was solidly abutted against the river's high and rocky bank at one or its eastward end; the western end of it rested on or a few feet into the face of a bank of quite a different nature on the opposite side; where not only does the rock rise to or crop out at level of bed of river; but the material above it and for a height of some 50 to 60 feet is nothing but the most irresisting soft clayey sand and vegetable mold.

Had the precaution, an expensive one of course, been resorted to, as was done at Grand Mére on the St. Maurice, in an absolutely similar case, of rip-rapping the face of the cliff from the dam to some distance up stream or of a wooden revetment against wash and scour of river, the accident likely might not have happened. It would certainly not have occurred had this cliff revetment been made water tight to a certain height, even though it should have cost an extra $20,000 or more to do so along a stretch of 200 to 300 feet.

What happened is this: the water having on the occasion risen to 30 feet, a pressure of 13 pounds to the square inch or close upon 2,000 lbs. to the foot, a great tendency to filtration through the bottom of the bank (where the strain was irresistible by material of the light and loose structure alluded to) was brought about, and a leakage through and around the western end of the dam was seen to occur. Under such pressure and through such friable material it may easily be imagined how quickly the scour did its work, increasing in a few hours the water way through the bottom of the bank to the dimensions of a sewer and then enlarging sidewards and from below upwards, to the vastness of a tunnel, when of course the roof or over-lying earth caved in—the out rushing water in the mean time wearing away the side hill from below and causing the cliff to go piece by piece almost vertically in slices from 4 to 6 feet thick at a time, till the gap up stream from the dam reached to a distance of some 200 feet, while in the direction of the length or axis of the dam prolonged, the hill was cut into by not less than 300 feet and the scour down stream or below the dam wore away the bank of the river to a distance of more than 700 feet.

The quantity of material carried away—the cliff as already stated being some 60 feet high—is not less than 300,000 cubic yards discoloring the water of the Saguenay for miles below the town and rendering it for the time being unfit to drink.

The dam will of course now have to be extended by some 300 feet or more to the opposite bank or to the present site thereof, while a temporary dam will have to be built to confine the water to passing over the present dam till the extension is put in; but the whole structure should be widened out down stream by say 20 feet, to support a bridge and gate superstructure of some 25 to 30 feet in breadth and capable of holding its own against any subsequent rise of like magnitude in the river; and this should be done at any cost and in the company's own interests: for as the area of the reservoir or breadth of water upheld will hereafter be of so much greater an extent westward, a second accident of the kind might sweep down upon the city and destroy thousands of dollars worth of property, with probably or at any rate possibly loss of life for which the company might be held responsible—and a stitch in time saves nine.

I would also say here in relation to the new concrete dam at the Chaudiere—it was quite a question this spring whether it would not give under the immense ice pressure against its almost vertical inner or upper face, and my surmises of last fall when writing on the subject have now become a certainty, and to the effect that inward of this concrete rampart should be made an inclined apron of crib-work of two or three feet of base to one of height boarded over with deals or plank laid parallel to the flow of water, and such that any future tendency of an ice jam against the dam will be done away with by the certainty that the swell of the ice forward or down stream will shove it up the incline and topple it over the dam in a way to do no damage to the permanent structure.

## PROGRESS IN ELECTRIC LAMPS.*

By Prof. Andre Blondel.

The object of this paper is to pass in review the improvments realised up to the present, and those still to be hoped for, in arc and incandescent lamps.

Progress In Arc Lamps—.During the past 10 years great strides have been made both as regards the theory and the contruction of arc lamps. Our theoretical knowledge of the properties of the arc has greatly inceased. The measurements of M. Violle have shown that the maximum temperatures reached in the arc 3,500°C. at the positive, 2,700°C. at the negative carbon, andalsothat in a closed space thebrightness andthe temperature ot the crater are constant. Again, after adiscussion, joined in by many authorities, it seems now settled in conformity with the present author's conclusions that the back E.M.F. in the arc exists only as arising from the arc's resistance, which can be considerably modified by the addition of salts to the crater. Mrs. Ayrton's experiments have connected by simple laws various phenomena of the arc ; in particular they have shown that the energy consumed is a linear function for each diameter of the carbon. That the apparent resistance varies not only with the diameter of the carbons and the length of the arc, butalso withnature of thecarbons and the surrounding gas has been shown by various experimenters. Mr. E. Wilson, repeating an experiment by M. Cailletet, has shown that the brightness of the positive carbon diminishes when the pressure is increased, and that by the withdrawal of gas a carbon mist is produced. M. Le Chatelier has attributed the constancy of the temperature of the crater to the presence of fusing carbon there. In addition, the author's experiments have shown that in free air the brilliancy of the arc increased with the current, and passes from 150 candles per square millimetre for small arcs to 220 candles per square millimetre for powerful arcs. Mrs. Ayrton, in her reserches on the hissing of the arc, discovered that the hissing is caused by the advent of oxygen at the crater ; and that the phenomenon does not occur below certain current density, and is preceded by Trotter's phenomenon of the rotation of the arc on itself.

As regards the altenating-current arc the author has given a detailed analysis of its periods of lighting and extinction, and of its current and voltage curves ; he has shown the parts played by the resistance and the self-induction of the circuit, the conductivity of the core, and the form of the E.M.F. curve of the generator.

The electric arc does not conform to Ohm's law, for increase of current produces widening of the arc, and consequently a diminution of the resistance. This leads to instability, which must be guarded against, on a constant-potential supply, by the inclusion of a resistance in series. This instability was studied by the author in 1891 by drawing "characteristic curves of extinction," in which the potential difference between the lamp terminals was plotted for various current.

As regards the mode of regulation, the differential system seems now universally admitted to be the best. We may take with the minimum voltage of 30 volts for the arc a potential drop of 1·5 volts in the steadying resistance for alternating arcs, and with 33 volts a fall of 3·5 volts to 4 volts in the resistance for continous-current arcs. The use of shunt-lamps presents some advantages over the differential system ; the lamps are simpler ; there is no risk of burning out by too strong a current ; and they permit of easier regulation of the current within wide limits.

The oscillographic study of the extinction of the arc without additional resistance, shows it to take place slowly, the phenomenon requiring about 1 10sec. or even more for its completion. This indicates that with quick-acting and sensitive mechanism the normal arc may be uninterruptedly maintained with only small steadying resistance in series. The inertia of the moving parts leads to hunting however, unless the vibrations set up are rapidly damped by a dash-pot. In the best modern lamps, air dash-pots are employed, and the adjusting mechanism has reached great perfection. Arc lamps have numerous constructional conditions to satisfy. They must be able to stand rough handling and every weather, and must be capable of easy and qnick replenishment and repair. It is noticeable that of recent years there has been a tendency to revert to the use of clockwork mechanism on account of its great sensitiveness and small consumption of energy. As for motor mechanisms, they are rather complicated when continuous currents are used, but with alternating currents assume various elegant forms of the type of a metal disc embraced by electro-magnets of suitably differing phases. With certain types of mechanism in alternating current lamps the self-induction of the regulating coils tends to reduce the sensitiveness. This self-induction effect might be compensated, as M. Claude has suggest-d, by proper condensors. The self-induction, however, tends also to keep the impedance almost constant, in spite of variations ot the resistance of the coils through temperature alterations, and so gives the alternating-current lamp some advantage over the continuous-current lamp. In the latter lamps ingenious temperature compensators have been adapted, but these unfortunately leave uncorrected the variations of the resistance produced by the shortening of the carbons. Improvements in mechanism have brought many good double carbon lamps into use ; among these the Crompton-Pochin, Brockie-Pell, and Korting and Matheson lamps may be mentioned. The author has for a long time considered that these lamps are very efficient as regards the utilisation of the energy supplied. Besides this they require little labor and are economical in carbons.

Modern methods of lamp grouping differ greatly from the old system, in which the employment of isolated lamps was necessary. One modern tendency is, however, to use high-voltage enclosed lamps working directly at 110 volts ; another is to use, as of old, two lamps in series, each absorbing from 30 to 35 volts. In both these cases the steadying resistance is important. But by the construction of differential lamps the importance of the steadying resistance is minimized. Low-voltage lamps have been in use since 1889, but it was not till atter 1897, when the Hegner (Volta) lamp appeared, that the low-voltage lamp entered largely into industrial practice. Siemens and Halske, as also Korting and Mathieson, in their low-voltage lamps use, at starting, a high resistance which is afterwards gradually removed. With these the fear arises that, in spite of the perfection of the mechanism, certain circumstances may lead to a dangerous increase of the currrent. Hegner, using also differential lamps, but without special mechanism, puts three in series with an

*Abstract o a paper read at the Internatio al Congress of Electri ity, Paris.

automatic rheostat of four parts, which are removed successively as the lamps get started, thus securing a more stable and less dangerous arrangement than the former. Still more recently Vigreux and Brille have proposed a special mechanism on the differential system which without springs, weights, or frictional appliances, can produce a very rapid recoil of the carbon if the arc becomes shortened. The advantages of these low-voltage lamps are that they enable a better distribution of illumination to be effected and that they are more economical as regards consumption of energy. Against these advantages must be set, however, the heavy initial expense, the complication and delicacy of the mechanism, and the necessity for carbons of very special quality.

With these lamps, grouping by threes is called for only on short, small-resistance circuits. When large areas are being supplied the leads furnish sufficent steadying resistance for the usual arrangement of two arcs in series. In any case it is only on circuits at 110 volts and when sub-division of the illumination is desired, that low-resistance lamps are specially useful. When, however, the distribution is made at 220 volts, and especially when 220 volts is to be substituted for 110 volts in an existing circuit, a reduction of the number of lamps under a given voltage should rather be aimed at. The solution of this problem is afforded by the enclosed arc lamp.

Illumination by arc lamps in series, with both continuous and alternating currents, is still much in vogue in the United States, but has been almost completely abandoned in Europe on account of the lack of independence among the lamps, and the dangers accompanying the use of high-pressure currents. A recent application in this direction in England consists in the employment of constant-current transformers and Ferranti rectifiers, and thus allows the use of lamps giving a better light distribution than alternating-current arcs. The pulsating current produced is, however, as dangerous as alternating currents. On the Continent commutator transformation to continuous current, or the use of alternating-current lamps with reflectors, is preferred.

The enclosed arc lamp did not assume importance till 1894. It is characterized by having a very long arc using a tension of 75 volts to 80 volts. In the Marks (or Jandus) lamp the arc is surrounded by a double globe, the inner one of which possesses a valve (check-gas plug), which permits expansion of the contained air. The outer large globe is protective, and becomes filled with gas from the inner globe. In these circumstances the carbons are consumed very slowly, and the arc itself is modified in character the upper positive carbon is, through rotation of the arc, scarcely hollowed, the lower negative carbon is plane, while their normal distance apart is 8mm. at 80 volts. The mechanism of all makes of these lamps is of the most rudimentary type. And since the carbon consumption is small the displacement of the luminous spot is very little. The advantages of these lamps are: Their independence of one another, the ease of their application in 110 volts or 220 volts systems, the extreme simplicity of their mechanism, the employment of cheap carbons, the small consumption of the carbons, and the reduction in the amount of attention necessary. Their disadvantages are, on the other hand, the blue tint in the light, the variations of brightness which render almost necessary the use of a diffusing globe, the fouling of this by a silicious deposit, and the mediocrity of the light from large carbons. The disadvantages attending the use of alternating-current enclosed lamps remain still so numerous that this type of enclosed lamp cannot yet be regarded as a success.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

At the regular meeting of Toronto No. 1, C.A.S.E., held on the 19th ult., the following officers were elected: President, W. J. Webb; vice-president, R. H. Johnston; recording secretary, W. H. Johnson; financial secretary, N. V. Kuhlman; treasurer, S. Thompson; conductor, T. D. Bly; doorkeeper, J. Fox; trustees, J. Huggett, J. Bannan, N. V. Kuhlman; delegates to convention, W. J. Webb, J. Huggett, J. Bannan, W. L. Outhwaite and N. V. Kuhlman.

Hamilton branch has elected the following officers: F. J. Sculthorp, president; J. A. Ferguson, vice-president; J. Ironside, recording secretary; G. W. Dawson, financial secretary; W. R. Cornish, treasurer; R. C. Pettigrew, conductor; N. Kitchen, doorkeeper; R. C. Pettigrew, Thomas Elliott, Peter Scott, trustees; Joseph Ironside and T. Chubb, representatives to the convention to be held in Brantford on August 20th; F. J. Sculthorp and J. A. Ferguson, alternates.

Toronto No. 18, on the 28th June elected the following officers:—President, Thomas Graham; vice-president, John J. Richardson; treasurer, P. Trowern; financial secretary, W. Inglis; recording secretary, John M. Dixon; conductor, James Coulter; doorkeeper, G. Gracey; auditors, Joseph Hughes and A. W. Vance; delegates to convention, J. M. Dixon and P. Trowern.

## THE JOHN SCOTT MEDAL.

The Franklin Institute of Philadelphia issues each year a premium and gold medal which are awarded on account of what is considered the most noteworthy achievement in electrical science during that year. This is known as the John Scott Premium and Gold Medal.

We have recently been advised that the award for this year has been made to the General Electric Co., on account of their series alternating system of street arc lighting.

During the two and a half years the system has been before the public, 230 central stations have ordered 22,000 arc lamps for operation on this system, distributed in all parts of the world:—United States, Canada, Australia, Brazil, British Guiana, China, Costa Rica, Cuba, England, Mexico, Newfoundland, Peru, South Africa.

## TO OUR READERS.

The advertisement pages of this number contain the announcements of the leading manufacturers and dealers in electrical appliances, and should therefore prove of much interest and value to our readers. These manufacturers will be pleased on request to send you full particulars of their goods, and will appreciate mention of their advertisements in the Electrical News.

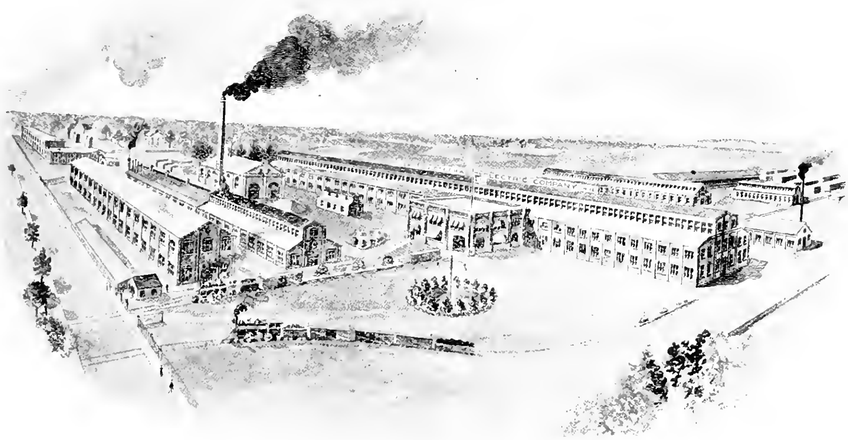
CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. XI. AUGUST, 1901 No 8.

## A CANADIAN MANUFACTORY OF ELECTRICAL APPARATUS.

FEW of our readers realize the magnitude to which the electrical enterprises in this country have developed, and that it has been a matter of great difficulty for the factories to keep pace with the rapidly growing demands, the result being that many orders were given to manufacturers outside of Canada.

In order that Canadians might reap the advantages of home production in electrical apparatus, the Canadian General Electric Company have recently enlarged their extensive works at Peterboro, of which the accompanying illustration gives a very good idea.



VIEW OF THE WORKS OF THE CANADIAN GENERAL ELECTRIC COMPANY, PETERBORO, ONT.

The "electric works" are now employing about 600 hands, giving them first place and high esteem in that thriving community of ten or twelve thousand souls. It is impossible to approach or leave the town without seeing the handsome buildings within the enclosure of about 40 acres. There are nearly twenty buildings, all reached by track, and all raw material or finished product is delivered or taken away by means of switches to the main tracks of the Canadian Pacific Railway and the Grand Trunk Railway systems.

The largest building is the machine shop and office building; it is 540 feet long, 110 feet wide, and 60 feet high, with a gallery 25 feet wide on each side.

The next three largest buildings are 272 feet long, 50 feet wide, and two stories high. The one on the left is devoted to the manufacture of incandescent lamps and covering wire. The second building is for storage and compounding wire, also making rubber covered wire. The small building in the rear is the boiler house, providing steam for heating, etc. The other buildings on the right are used for smithy, foundry, carpenter and pattern shop, etc. The buildings in the left background are utilized for the manufacture of carbons and porcelain goods.

Motive power is being supplied from the Company's generating station at Nassau, about six miles distant, where the development of a fine water power of 1500 horse power is nearing completion. The water wheels are of the horizontal turbine type, supplied by the Wm. Hamilton Company, of Peterboro. To them will be direct connected two 450 K.W. three-phase revolving field generators, operating at 138 r. p.m. and generating current at 60 cycles and 6,600 volts. There will also be provided a marble switchboard arranged so that either machine and line may be operated separately or in parallel.

The current will be transmitted to the works on two three-phase lines, constructed of No. 1 B. & S. copper wire in the triangle form, one circuit on each side of the pole. Four feet below is the telephone line, consisting of two No. 8 copper wires, suitably transposed to prevent induction. The insulators used in the power line are of the Locke type, 20,000 volts, composed of brown porcelain.

In the sub-station, situated behind the main machine

shop building, will be installed six air blast transformers of 140 K. W. capacity each, receiving the three-phase current at 6,100 volts and delivering it either two or three phase 575 – 1150 – 2300 volts, as desired. The air pressure is supplied by a direct connected blower set supplied in duplicate. Marble switchboards supplied with fuses and switches arranged to make all possible combinations of transformers and lines will be installed. All the electric apparatus is being made and installed by the Canadian General Electric Company's employees, and when completed will form a model plant in every respect.

## THE PRACTICAL SIDE OF THE INCANDESCENT LAMP.*

By Francis W. Willcox

Mr. Willcox referred to the well-known fact that a high-efficiency lamp is preferable for central station service, for the obvious reason that its use secures a

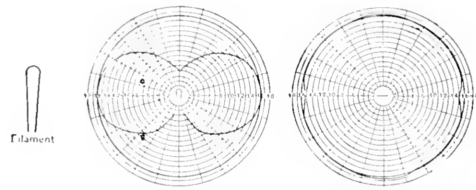



FIG. 1.—SINGLE LOOP FILAMENT.

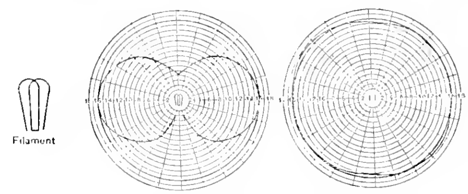



FIG. 2.—DOUBLE LOOP FILAMENT.

greater capacity of machinery and conductors, and a lower cost of light production. He then considered the actual relative value of the 3.1-watt and the 3.5-watt lamps, taking into consideration the disadvantages of the high-efficiency lamp as opposed to the advantages mentioned. The 3.5-watt lamp, he explained, has a useful life of about 800 hours, while the 3.1-watt lamp has a useful life of about 400 hours. It will, therefore, require two high-efficiency lamps to give the same useful lighting service that is rendered by one 3.5-watt lamp. The 3.1-watt lamp saves 6.4 watts in power consumption, so that for a period of

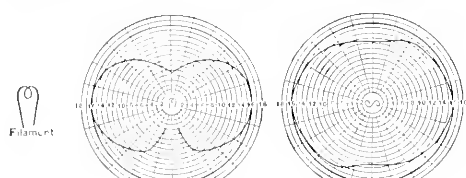



FIG. 3.—SINGLE COIL FILAMENT.

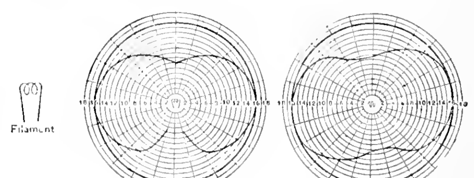



FIG. 4—DOUBLE COIL FILAMENT.

800 hours the total saving would be 5120 watt-hours as compared with a 3.5-watt lamp. This saving must be compared with the cost of an additional lamp. Figuring the price of the lamp at 18 cents, it is evident that the figure per kilowatt-hour at which the two lamps are equal in cost is found by dividing 18 cents by 5.12, which gives a cost of 3½ cents per kilowatt-hour. Below this figure the 3.5-watt lamp shows the lower cost, above it the 3.1-watt lamp is the cheaper. It must be noted, however, that these figures do not cover the value of the increased capacity in apparatus and lines resulting from the use of a higher efficiency lamp.

Besides the mere question of cost, the 3.1-watt lamp has the advantage of compelling timely renewals by burning out just beyond the end of the period of useful life. A large number of lamps tested by the Lamp Testing Bureau were allowed to burn until they broke instead of being taken down when the candle-power had diminshed to 80 per cent. of the rated power. The tests showed that the majority of the breakages occurred in the vicinity of the 500 and 600-hour points. Another feature of advantage in high-efficiency lamps is the better quality of light, its greater brilliancy and whiteness, and consequently more attractive appearance. Candle-power, Mr. Willcox stated, does not completely express the value of an illuminant, as is well known. It affords a satisfactory measure of light for use in reading—in the illumination of black and white, but the power of the light to bring colors increases with the temperature of the filament out of all proportion to the candle-power. Therefore, the high-efficiency lamp has the advantage as an illuminant against a low-efficiency lamp in most branches of modern lighting service, such as the illumination of show windows, stores, picture galleries, etc. With reference to lamp voltages, Mr. Willcox advocated the avoidance of lamps of the so-called standard voltages of 100, 104, 110 and 115, for the reason that the demand for lamps of these voltages is many times the supply and the purchaser therefore serves his own interests best by adopting some uncommon voltage, such as 107, 108, 113, 117, 122, etc.

Referring to high-voltage lamps (of 200 to 250 volts), Mr. Wilcox stated that there are over 500,000 of these lamps annually supplied to consumers in the United States, and that their use is being rapidly extended. Such lamps, however, until very recently have been limited to low efficiency, averaging four watts per candle. At this efficiency they give a useful life about 50 per cent. better than the 100-volt 3.1-watt lamp. They require, however, about 20 per cent. more power in station capacity for the same output in candle-power, and this has been a great drawback to their use. The superior distributing advantages of the 200-volt system and the resulting demand for these lamps have caused strong efforts to improve their efficiency, with the result that 250-volt lamps of an initial efficiency of 3.4 watts per candle for 16-c.p. and 20-c.p. lamps, and 3.1 watts per candle for higher candle-powers are now made to give an average useful life as good as the 100-volt 3.1-watt lamp, that is, about 450 hours.

With regard to candle-power, Mr. Willcox stated that while 16 candle-power still remains the standard of service in this country, there has been in the past

*Abstract of paper read before the National Electric Light Association, 1901.

few years a large and constantly increasing use of lamps of lower candle-powers, such as 10, 8, 6, 4, and 2. The lower the candle-power of the lamp, for a given efficiency, the more delicate becomes the filament, of course, and for equal results in life, therefore, lamps of low candle-power must necessarily have lower

TABLE I—SHOWING USEFUL LIFE OF INCANDESCENT LAMPS

| Watts per candle | 8 c p | 10 c p | 16 c p |
|---|---|---|---|
| 3.1 | | 335 hrs | 450 hrs |
| 3.5 | 610 hrs | 750 " | 800 " |
| 4. | 1110 " | 1650 " | 1600 " |

efficiencies than lamps of 16 candle-power. Table I herewith shows the average useful life of lamps of different candle-power at various efficiencies. The use

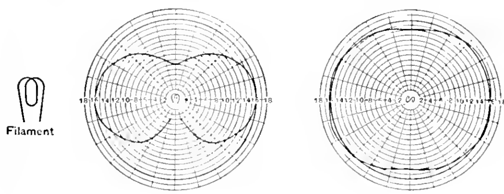



FIG. 5.—OVAL ANCHORED FILAMENT

of the lower candle-power lamps, Mr. Willcox stated, should be more general than it is, and they are to be recommended to all central station managers who desire to increase their business, especially among residences.

Mr. Willcox did not advocate the use of lamps of higher candle-power than 32. With reference to types of filaments, he presented the curves shown in Figs. 1 to 5, which speak for themselves. In each illustration the shape of the filament is shown on the left, the distribution of light in a vertical plane is shown next, and at the right is shown the distribution of light in a horizontal plane, in other words, the distribution below the tip of a lamp hung vertically.

Referring to the candle-hour performance of incandescent lamps, Mr. Wilcox pointed out that tests for candle-hour curves are conclusive only when there are tested a sufficient quantity of lamps of one make to secure a fair average, when the methods of testing are correct, and finally when the duration of the test is sufficient to bring out the qualities of the lamp. One of the details of importance in making such tests is to have the initial efficiency of the lamp accurately determined, certainly within 1/10 watt per candle. Such a difference seems a small one and it might be thought that it can be ignored, but it is sufficient to cause a difference of 100 hours in the performance of lamps of equal quality. The preferable efficiency at which to test lamps is 3.1 watts per candle, as lamps burned at this efficiency will give complete results in about one-half the length of time necessary for lamps burning 3.5 watts. If it is not possible to obtain lamps which correctly measure 3.1 watts per candle, the pressure can be raised at the socket so as to increase the candle-power up to the desired point, or the lamps can all be burned at a common voltage at various efficiencies and the results can afterward be corrected by the application of a correction factor taken from the chart shown by Fig. 6.

The curves in this chart give the changes of voltage, watts per candle and life corresponding to different candle-powers. These curves enable one to make the following comparisons: Given a certain candle-power and life, one can find the candle-power at another life, or the life at another candle-power; with a given candle-power and voltage one can find what the candle-power would be at another certain voltage, or what voltage would be required for another candle-power; given the candle-power and efficiency in watts per candle, one can find what the candle-power would be at another efficiency, or what the efficiency would be at another candle-power; given the voltage and life, one can find what voltage would be required to give some other life, and what life would result by using some other voltage; given the voltage and efficiency, one can find what voltage would be required to give any other definite efficiency, and what the efficiency would be at any other definite voltage; given the efficiency and life, one can find what the efficiency would be at another life, and what the life would be at any other given efficiency.

When the filaments differ in type, equal efficiency in watts per candle by horizontal candle-power measurements does not mean an equal strain on the filaments,

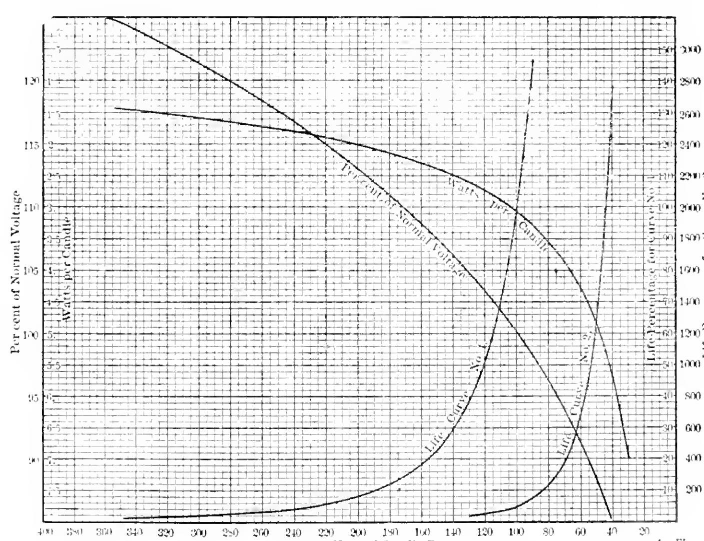



FIG. 6.—CHART SHOWING RELATION BETWEEN VOLTAGE, EFFICIENCY, CANDLE-POWER AND LIFE.

nor form an exact basis of comparison. In such cases it is necessary to consider the total spherical candle-power, and one of two courses may be pursued, namely (1) determine the watts per horizontal candle-power at which the different filaments in comparison with some standard will be on an equal basis of comparison, and set the different filaments up for candle-hour test at these respective efficiencies by horizontal candle-power

measurement ; (2) burn the lamps at an agreed initial efficiency, say 3.1 watts per horizontal candle-power, and then correct the results by the application of a correction factor determined for the different forms of filaments in terms of some standard filament. The accompanying table contains in one column the efficiencies as suggested by the first method, and in the other column the percentage ratios required for the use of the second method.

TABLE II TABLE FOR REDUCING RESULTS OBTAINED WITH DIFFERENT TYPES OF FILAMENTS, TO AN EQUAL COMPARATIVE BASIS, TAKING THE OVAL FILAMENT AS A STANDARD

| Type of filaments | Hor W P C at which to test lamps of various type filaments in order to burn them at the same temperature as oval filaments at 3.1 Hor. W P C | Factor by which to multiply effective life of various type filament lamps burned at 3.1 Hor. W P. C. in order to equate them with oval filaments burned at 3.1 Hor W. P. C. |
|---|---|---|
| Oval | 3.10 | 1.00 |
| Single spiral | 3.10 | 1.00 |
| Double spiral | 3.12 | 1.03 |
| Single loop | 3.02 | .555 |
| Double loop | 3.025 | .865 |

Mr. Willcox closed his paper by urging the use of free lamp renewals on the part of central stations, and argued very forcibly against allowing consumers to buy their lamps where and how they pleased. He described the method in vogue at the New Haven (Conn.) central station where the lamps in the business section are taken off the circuits and replaced with fresh lamps four times a year. The lamps brought into the station are cleaned by means of a small buffing lathe and photometered, or rather passed through a photometer, in order to ascertain whether they are above or below the "smashing" point.

## THOMSON RECORDING WATTMETER.*

By C. G. Carmichael

While comparisons between the meter and contract systems are no longer necessary, the choice of a meter is an important consideration : Shall it be an ampere meter registering the current, or a wattmeter registering the energy? To answer this let us examine effects of voltage on a 16 candle power, 3.1 watt incandescent lamp. A variation in voltage of 2 from normal is quite common, but the 2 variation given in Table 1 is sufficient for our purpose.

Table 1.—Effects of voltage on a 16 c. p., 3.1 watt incandescent lamp. Normal voltage 100.

| Volts. | Candle p'w'r | Watts per Candle | Amperes | Total Watts |
|---|---|---|---|---|
| 98 | 14·40 | 3·33 | 0·485 | 47·5 |
| 99 | 15.20 | 3·21 | 0·492 | 48·8 |
| 100 | 16·00 | 3·10 | 0·496 | 49·6 |
| 101 | 16·96 | 3·00 | 0·504 | 50·8 |
| 102 | 17·92 | 2·91 | 0·512 | 52·2 |

Suppose the electric light company is able to dispose of its power at the low rate of 10 cents per kilowatt hour. From Table 1 we see that a 16 c. p., 3.1 watt lamp at normal voltage takes 0.496 amperes. Since an ampere meter is calibrated from an indicating wattmeter, the voltage being kept constant at normal, for this case a rate of 10 cents per k. w. h. is same as 1 cent per ampere hour. Also here a rate of 10 cents per k. w. h. is same as 0.031 cents per candle power hour.

We can now deduce the following table of charges per lamp hour, according to above three methods.

Table 2. Charge per lamp hour.

| Voltage | Charge per lamp hour at 10 cents per K. W. H. | Charge per lamp hour at 1c. per ampere hour. | Charge per lamp hour at 0·031c. per candle pow'r hour. |
|---|---|---|---|
| 98 | 0·4751c. | 0·485c. | 0·4464c. |
| 99 | 0·4880 | 0·492 | 0·4712 |
| 100 | 0·4960 | 0·496 | 0·4960 |
| 101 | 0·0588 | 0·504 | 0·5258 |
| 102 | 0·5220 | 0·512 | 0·5555 |

It can thus be seen that when voltage is below normal the ampere meter records more power than is used, and when voltage is above normal this same meter records less power than is actually consumed. Apparently it might therefore be argued that it would pay to use ampere meters and keep the voltage low. But any electric light company could soon tell you how many customers it would have at the end of a year were it to supply only 14 c. p. and charge for 16 c. p.

Now consider the customer. He wants so much light. Virtually he wants to pay so much per candle power hour. Say he is a merchant and in a year he uses 200 sixteen candle power lamps for 500 hours or 100,000 lamp hours. From Table 2 his lighting bill is found.

For a voltage of 98—

By Wattmeter his bill would be..........$475.10
By Ampere Meter his bill would be....... 485.00
His just bill at 0·031 cents per c. p. hour is . 446.40

That is, Ampere Meter charges him too much by $38.60, and Wattmeter too much by $28.70, that is, Wattmeter is more nearly correct by $9.90.

For a voltage of 102—

By Wattmeter his bill would be..........$522.00
By Ampere Meter his bill would be....... 512.00
And his just bill at 0.031 cts. per c. p. hour is 555.50

That is, by registration of current the merchant is charged too little by $43.50, and by registration of energy too little by $33.50, again showing a difference of $10.00 in favour of the Wattmeter.

The first requirment essential to a perfect recording meter is therefore registration of energy and not current, one of its factors. A meter must be simple and durable ; able to resist tampering and independent of atmospheric conditions ; independent of frequency and inductive circuits and must be adaptable to either direct or alternating current.

I will attempt a brief description of the Thomson Recording Wattmeter. In fig. 1 is shown a 5 ampere, 220 volt meter, the connections being shown in fig. 2. It is simply a small motor and dynamo combined. A small fraction of the energy which the meter measures operates the motor, and the retardation is supplied by he light drag of a copper disk rotating between the poles of two magnets.

*Paper read before the Engineering Society of the School of Practical Science, Toronto. Published by permission.

The armature consists of a number of coils of fine wire wound upon a frame of pressed paper, which is fastened to the vertical shaft. The commutator bars are made of silver and the brushes are tipped with that metal. The armature, in series with a suitable resistance and the shunt, is connected across the line. The fields consist of a number of turns of stout copper wire of size sufficient to carry a current of twice the rated capacity of the meter. These fields are connected in series with one side of the line, the full current passing through them. Hence the torque of the motor is exactly proportional to the watts.

There is no iron about the motor, and the meter when once calibrated is adaptable to either direct or alternating current. In fact were we to replace the brushes by two connections affixed to opposite segments in the commutator and attach a suitable spring and pointer to the shaft, we would have an indicating wattmeter capable of being used on any circuit.

The copper disk rotates between the poles of two magnets. By moving the magnets out or in the speed is regulated so that the number of revolutions of the disk in a certain time corresponds to energy delivered to the circuit in that time. On the shaft is a worm which operates the recording mechanism.

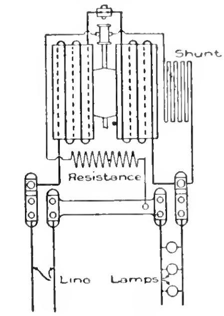
As before stated the shunt is connected in series with the armature and resistance across the line. It consists of a suitable number of turns of fine wire and is inserted in the inside of one of the field coils. Its object is to assist meter on light loads, thus giving the meter great accuracy on all loads.

In the lower end of the shaft is a polished, hardened steel detachable pivot. The shaft sits on a jewel mounted on a spring in the end of a screw. So that if from any cause jewel or pivot should be damaged both can be easily removed and replaced by new ones without removing the cover. The meter is protected by a metallic cover which is drawn tightly down on to a strip of felt on the base, thus rendering it dust proof. To the underside of the base is fastened a metallic plate. When it is sealed up it is impossible to tamper with the meter without breaking the seals.

Wattmeters are tested by connecting them up with an indicating Wattmeter; and with a stop watch noting the time of a certain number of revolutions of the disk. The formula,

$$\frac{3,600 \times \text{constant} \times \text{number of revolutions}}{\text{time (in seconds.)}}$$

gives watts recorded by the recording meter and this should agree with the reading of the indicating wattmeter. If there is not a close enough agreement the magnets are moved out or in, according as meter is fast or slow.




Two wire, up to 50 amp

FIG. 2

The formula is derived as follows:

Let 1 revolution of disk in one hour = 1 watt hour.

Hence 1 revolution of disk in 1 sec. = 3,600 watt hrs.

Or N revolutions of disk in 1 sec. = $3,600 \times N$ watt hrs.

Or N revolutions of disk in t sec. = $\frac{3,600 \times N}{t}$ watt hrs.

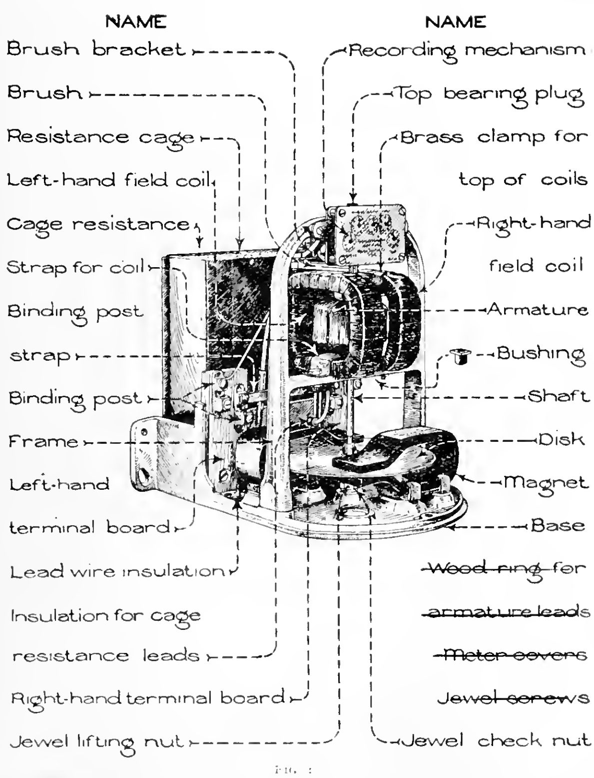



FIG. 1

Now suppose we took a 25 amp., 100 volt meter and passed 100 amperes at 100 volts through it, the disk would rotate at the abnormal speed of 166.68 r.p.m. If the field coils were made with one-quarter of the number of turns of wire the torque, and hence the speed of the disk, would be one-quarter of what they were before. Since the disk is running at one-quarter of the speed necessary to record the power in the circuit, the dial will indicate only one-quarter of the power, so the dial reading is muntiplied by 4, or as it is termed "constant 4." The formula becomes

$$\frac{3,600 \times \text{constant} \times \text{number of revolutions}}{\text{time (in seconds).}}$$

Another way of looking at it is—

Let W = watt hours.

N = number of revolutions.

t = time in seconds.

K = constant.

$$W = 3,600\frac{N}{t}$$

W = Relovutions per hour.

$$W = K\frac{3,600N}{t}$$

By choosing the proper value for $\frac{3,600N}{t}$ we can have any value of K, $\frac{1}{2}$, 1, 2, etc., depending on the size of the meter.

Everything should be carefully considered before selecting the proper size of wattmeter to be used. If a building is to be illuminated with 400 lamps it does not of necessity follow that a 400 light meter will do.

When a meter is set up it should be examined annually by a competent person. Don't suppose that it is going to run forever after it has first been inspected and then sealed up.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA
Telephone Main 2362.
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Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the anadian Electrical Association.**

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**Automatic Telephone Systems.** THE important announcement is made that the German government has purchased the exclusive rights to the Strowger automatic telephone patents, and the system will be installed in Berlin and other cities throughout the German Empire. This purchase has been made as the result of a report upon the system by A. Feyerabend, head of the German telephone and telegraph system. The Strowger Company, of Chicago, from whom the rights to manufacture and use the system were purchased, had an experimental automatic exchange of two hundred instruments working for upwards of a year in the government offices in Berlin. The result of the more extended operation of the system will be watched with much interest.

**The Telephone.** SUBSTANTIAL progress is constantly taking place in the telephone field, although we do not perhaps hear so much about it as of the developments in the application of electricity to the production of light and power. One of the latest uses to which the telephone has been applied, is the despatching of trains on steam railways, a field in which the telegraph has until recently been exclusively employed. The Delaware, Lackawanna and Western Railroad, operating a system of lines between New York and Buffalo, has announced its intention to adopt the telephone instead of the telegraph for despatching purposes on its main lines. The Erie Railway is said to have used the telephone in this connection with satisfactory results. The Albany and Hudson Railway also uses the telephone extensively for despatching purposes. The advantages claimed for it are, greater speed and less expense in delivery of despatches. It is claimed that the use of the telephone as compared with the telegraph does not increase the number of mistakes.

**Capital and Labor.** THE great combinations of capital and the aggressiveness of the unions of workmen in the United States, is bringing to a focus sooner than was expected the settlement of the relations that shall in future prevail between employer and employee. The most gigantic strike in history is now in progress between the steel workers and what is known as the United States Steel Trust. The employers are said to be losing a third of a million dollars per day, and the employees about half that sum. Upon the outcome of this great struggle will largely depend the conditions which are to govern, at least for a time, the relations of the combatants in the future. It seems impossible at present to forsee what the ultimate and permanent solution of the difficulty will be. It would seem, however, that there must either come a better understanding between employers and employees, by which regard will be shown for the interests of both, or the government must step in and compel the settlement of disputes by arbitration. In New South Wales, a compulsory arbitration law now prevails, and is said to be working satisfactorily. In Canada we have what are called Conciliation Laws, which provide means for the adjustment of disputes where both parties are willing to submit their case to arbitration. These laws appear to be a dead letter. The statement is made that in the present strike of trackmen on the C.P.R., which is a hindrance to public traffic, no request for arbitration has been made by either of the parties to the dispute.

If the law is to be invoked, it must, to be of any service, be compulsory. It is most unfortunate that these disputes regarding wages and hours of labors should be allowed to block the wheels of industry in prosperous times, and hasten the return of commercial depression.

**An Important Judgment**

THE judgment rendered by Mr. Justice Andrews in the Superior Court of Quebec, in the action brought by the Quebec Railway, Light and Power Co., against the Jacques Cartier Water Power Co., printed in full in this number, is of the greatest importance to electrical companies as well as to municipalities and users of electric light and power. The plaintiffs claimed damage to their property and business from the defendants' poles and wires, and asked the courts to compel their removal. The judgment is in favor of the plaintiffs' and is based on the principle that the plaintiffs having been first established, the second company is not entitled to cross their wires at any place or height. Confirmation of this principle would seriously affect the majority of electrical companies throughout Canada and the United States, where the universal practice has been for the companies to cross each others' wires. As long as the overhead system is used, it would seem as though the crossing of wires could not be entirely avoided. The effect of Judge Andrews' decision, if sustained, would be to cause endless trouble and expense to the electrical companies, create monopolies, and retard the progress and benefits of electricity. An appeal will be taken from the judgment, and we shall be greatly surprised if it is not reversed by the Court of Appeal or the Privy Council.

**The Canadian Electrical Association**

IT is to be hoped that the instructors in the electrical departments of our Canadian Scientific Schools will urge upon their students the desirability of becoming student members of the Association under the provisions of the amended constitution adopted at the recent Ottawa convention. The cost of student-membership is only one dollar per year. The advantages of acquaintanceship and association with the men who are actively connected with the commercial applications of electricity, should be worth a much larger sum to the student. Having decided to cultivate closer relations with the young men who are fitting themselves for a place in the ranks of the electrical workers in the future, the Association might consider the advisability of establishing for the benefit of its members a carefully selected technical library. It having been decided that no funds of the Association shall hereafter be used for entertainment, a sum of one hundred to one hundred and fifty dollars per year hitherto expended in this direction, will in future be available for other purposes. Why not use this money, or a portion of it, to purchase books for a circulating library? Each member of the Association might be given the use for a limited period of such books as he might desire, charge being only made for postage, neglect to return books promptly, or any damage to books while in the borrower's possession. Technical books are necessarily expensive, and only the few can afford to own a well-appointed library. Hence the probability that if one were established by the Association, it would meet a well defined need of present members, as well as of many persons outside, who might thereby be induced to connect themselves with the organization.

**To Station Managers and Engineers.**

MR. Station Master or Engineer, your attention, please! In the performance of your many duties during the 365 days of every year, do you not sometimes as the saying goes, "strike a snag"—find yourself face to face with a difficulty which you have never encountered before? In such an event, what do you do—wrestle with the problem until you have solved it, or get somebody with more experience to help you out? A Department of Questions and Answers has been established in this journal, to assist in the solution of such problems as are likely at any time to confront sation managers and engineers. It is at your service, either to obtain or impart information. If some unusual experience has come to you, tell us about it, and how you managed to get over the difficulty. Such information is certain to prove valuable to somebody in a similar situation. If you have a difficulty which you don't know how to deal with, or desire information which is not readily obtainable, drop us a line stating what is required, and somebody with the requisite knowledge will no doubt be willing to help you. In sending in questions, or answers to those of some one else, it is not necessary that your name should appear in print, but name and address should be supplied the editor for his information, and as a guarantee of your bona-fides.

**Decadence of the Exhibition.**

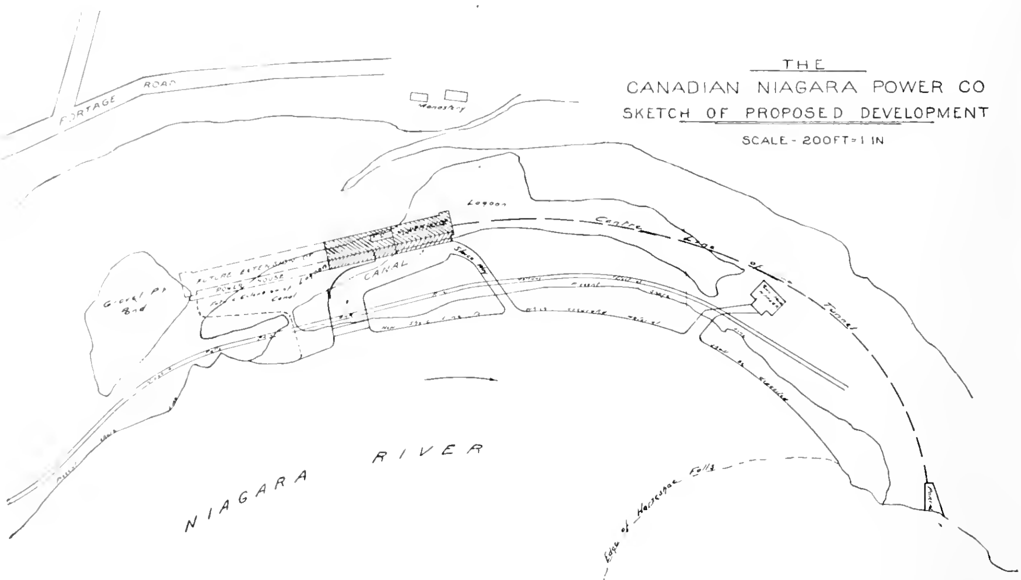
In point of attendance the Pan-American Exhibition at Buffalo has thus far proved a failure. The holiday season, during which the largest attendance might reasonably be looked for, will soon have passed, yet the expected thousands have not put in an appearance, and in consequence it is rumored that the Exhibition may close at an earlier date than was intended. The fact is apparent that the Exhibition business has been overdone. The original idea of these large Exhibitions was to bring together the most improved devices and methods in manufacturing, as well as specimens of the natural products of the nations of the earth. So long as this was the prominent feature, and an interval of at least ten years was allowed between the Exhibitions, they were reasonably successful. In recent years, however, projects of this kind have become too numerous, while their educational value has seriously declined. The Exhibition of to-day is a huge bazaar and circus combined, depending for success not upon its ability to instruct, but to amuse and excite wonder. It is not surprising that agriculturists, inventors, manufacturers and artisans no longer think it worth the cost to exhibit, or the earnest worker in any department to travel long distances to visit modern shows. The city of St. Louis, where arrangements have been in progress for a year or more for an Exhibition on a large scale next year, has wisely taken warning by the failure at Buffalo, and postponed the event for at least three years. It is perfectly safe to assume that if with all its advantages of situtaion, the Buffalo project has failed, St. Louis could not succeed in inducing northerners at least to exchange the cool breezes at the seaside, or by the great lakes, for her stifling atmosphere. She would do well to substitute for her proposed Exhibition a winter carnival. Canada's resources have only recently reached the point which would justify her in attempting to inaugurate a Dominion Exhibition. In view of the evident decline in public favor of such enterprises, the wisdom of embarking thereon now seems open to question.

## POWER DEVELOPMENT AT NIAGARA FALLS.

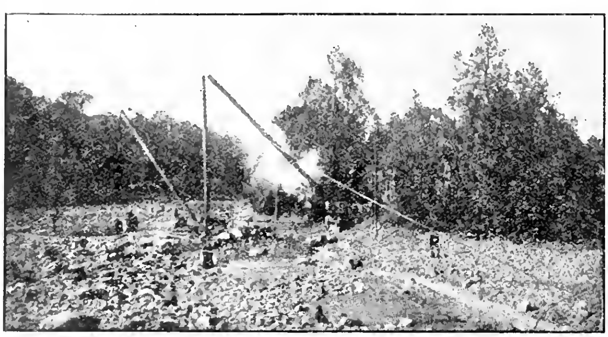
THE accompanying map will give our readers a fair understanding of the location of the proposed development work about to be carried out on the Canadian side of Niagara Falls by the Canadian Niagara Power Company. The work is now in progress, the contract being in the hands of A. C. Douglas, who has had considerable experience with excavations connected with the power development on the New York side at the Falls. Mr. Cecil B. Smith, Ma. E., of Toronto, has been appointed resident engineer.

The company have agreed with the Ontario Government to expend on these works within two years a million and a half dollars. Arrangements have been made for the complete construction of the first installation of the company, comprising a tunnel of 100,000 horse-power capacity, an inlet canal, and a wheel-pit of 50,000 horse-power capacity, together with the installation of electrical and hydraulic machinery to develop 25,000 horse-power.

The wheel-pit for the first section will be about 250 feet long, while its depth will be approximatey, 200 feet. The tunnel that will serve as a tail race will be built in the form of a horseshoe, similar to the tunnel on the New York side, but the section will be somewhat larger. In length the tunnel will be about 2,200 feet, its portal being at the foot of the Horseshoe Fall. The length of the tunnel on the New York side is over 7,000 feet. From this it will be seen that the development on the Canadian side will require the construction of a tunnel of only about one-third the length of the tunnel on the New York side, greatly lessening the cost of development. The minimum capacity of the tunnel will be 100,000 horse-power. The Canadian wheel-pit and tunnel will be lined with brick throughout, the same as the pit and tunnel on the opposite side of the river.




The second illustration shows the sinking of the first shaft.


SINKING THE FIRST SHAFT—CANADIAN NIAGARA POWER COMPANY'S WORKS.

## THE ALMONTE ARBITRATION.

THE arbitration case between the town of Almonte and the Almonte Electric Light Company, to determine the value of the plant of the latter, has been concluded. The action was the result of an offer made under the Conmee Act by the town of Almonte to purchase the plant of the Almonte Electric Light Company for $10,000. This amount was refused by the company, who asked $18,000. The board of arbitraitors was composed of Judge McTavish, of Ottawa, Judge Liddell, of Cornwall, and J. H. Burritt, of Pembroke. A great deal of expert evidence was taken, but it is said that the proceedings were carried on in a most harmonious manner. The award of the arbitrators fixed the value of the plant at $14,750 and directed the town to pay the cost of the arbitration in any event. Thus the award is $4,750 more than the town offered, and $2,250 less than was asked by the company.

## AN IMPORTANT LEGAL DECISION AFFECTING THE RIGHIS OF ELECTRICAL COMPANIES.

QUEBEC RAILWAY LIGHT AND POWER CO., VS. THE JACQUES CARTIER POWRR CO.

The following important judgment in this case was given by Mr. Justice Andrews in the Superior Court, at Quebec, on June 15th last: Whereas the plaintiffs and defendants being engaged in the same kind of business, viz., the furnishing of electric light and power in, and in the neighborhood of, the city of Quebec, the plaintiffs also owning and operating an electric railway there, the plaintiffs on the first ground complain that the defendants, by their works, poles, and wires, are obstructing and endangering the business, plant and property of them, the said plaintiffs, and over that the defendants have no right to carry on their business or occupy the roads or streets of the city.

Whereas the defendants by their own plea deny that they obstruct, or in any wise injure, the plaintiffs' averring that they, the said defendants, are acting within their charter rights, and retort that the plaintiffs are without such rights.

Whereas after proof and hearing on the merits the Court, to wit: on the 9th June, 1900, by interlocutory judgment, ordered that by three sworn experts, certain matters and facts in contest between the parties should be examined and verified; and in conformity with such interlocutory order three experts were duly named and appointed and have duly fyled their report; which report the plaintiffs have moved to homologate in part, and the defendants have moved to reject; and the parties have again been heard by their counsel, as well on the said motions as on the merits of the case, as affected by said report ;

Considering that both the plaintiffs and the defendants have established their charter-right to carry on their business in the city and district of Quebec ;

Considering that the plaintiffs had duly established their plant, poles, wires and business in the said city and district of Quebec before the defendants had begun the construction of their works ; part of the plaintiff's said business being the lighting of the city streets and public places ;

Considering that the plaintiffs, where they were in occupancy of streets or public places in the city of Quebec, or of portions thereof, with their said poles and wires prior to the advent thereto of the said defendants, have rights resultant from such occupation, which, though not exclusive rights, entitle them to protection and to being maintained in such possession or occupancy as is reasonable ;

Considering it is established that the defendants have so constructed their line that it, at certain points, constitutes an illegal interference with the plaintiff's said line, or system, and with their said business; and that the dangers, detriments and injuries thereto thereby occasioned justify the plaintiffs in asking rédress from this court ;

Considering that the suggestions of the said experts for the diminishing of the dangers involves such an interference with the property, poles, wires and appliances of the plaintiffs as renders such suggestions impossible of adjustion, and that their adjustion would not be just to the plaintiffs, nor in all cases protect them from danger and detriment ;

Considering that the plaintiffs have established by the said report of said experts, and by the other evidence of record, that the poles and wires of the said defendants are in dangerous proximity with those of the said plaintiffs, at all the points complained of in the plaintiff's declaration, except the intersections of said wires at Acqueduct and Massue streets, Crown street, opposite Merchant's Club, McMahon and D'Auteuil streets, Angele and Elgin streets, and Ursule and St. Louis streets ;

Considering that the motion of the said defendants for the rejection of the said reports of said experts is irregularly made, and is also on its merits inadmissible, and unfounded : the said motion is rejected with costs : and it is hereby adjudged and ordered that the said defendants do, within three months upon the service upon them of the present judgment, remove all the wires, poles and other constructions, so as aforesaid in dangerous proximity with those of the said plaintiffs, to wit, at the intersections of the following streets in the city of Quebec, viz.: of St. Francis and St. Dominick, St. Francis and Grant, St. Francis and Bridge, St Francis and Crown, Jacques Cartier and St. Francis, St Francis and Dorchester, St. Francis and Caron, St. Francis and St Anselme, St Francis and Boulevard Langelier, Church and Prince Edward, Church and Queen, Church and Richardson, Church and King, Church and Helene, St Anselme and St Joseph, St. Valier and Turgeon, Colombe and near Boulevard Langelier, Francis and Boulevard Langelier, Bedard west of Boulevard Langelier, Bedard opposite No 42, Bedard and dela Violette, Bedard opposite No. 75, Bedard and Parent, Avenue, Bedard and Carillon, Valier street near Canadian Pacific Railway, Valier street near toll-gate, Montmagny and Dollard, Dollard and St. Sauveur, Dollard and St. Luc, Dollard and Germain, Dollard and Bayard, Dollard and Darocher, Chenier and Duquesne, Valier and Massué, Sauvageau opposite Nos 9 and 17, Sauvageau and Bagot, Sauvageau and Morin, Sauvageau and Hermine, Sauvageau, opposite No. 102, Sauvageau and Kirouac, Aqueduct and Montcalm, Aqueduct and Boisseau, Aqueduct and Morin, Aqueduct and St. Luc, Colombe and St. Germain, Colombe and Bayard, Colombe and Durocher, Colombe and Victoria, Colombe and Sauvageau, Colombe, near Sauvageau, Demers and St. Jude, St. Valier and St Jude, Boulevard Langelier and Notre Dame, Notre Dame and St. Anselme, Notre Dame and Caron, Notre Dame and Dorchester, Notre Dame opposite Nos. 11, 25 and 31, Notre Dame and Crown, Desfosses and Church, Bridge and Grant, Dominick and St. Rochs, St Paul and Haymarket, Arago and Belleau, Arago and Valier, Valier and Cote d'Abraham, Cote d'Abraham and Richelieu, Eustache and Richelieu, Glacis and Richelieu, McMahon and St. Angele, John and Dauphine, Dauphine and Ursule, Dauphine and d'Auteuil, d'Auteuil and Anne, Patrick and Eustache, Patrick and St. Augustin, Simon, D'Artigny, Ste. Genevieve, Lachevrotiere, Jupiter and Drolet, Scott, Palais and Valier, Lacroix and Paul, Ancien Chantier, St. Charles, Dambourges Hill, Sous le Cap, Sault au Matelot, St. James, Bell's Lane, St. James and Dalhousie, St Paul and Bell's Lane, St Antoine and Dalhousie, St. Antoine and St. Peter, Notre Dame Square, LePlace opposite Blanchard's, Notre Dame and Sous le Fort, Cul de Sac, Champlain, Sous le Fort and St Peter, Amable and Conroy, D'Artigny, St Michael and Scott, Lansdowne avenue and Grande Allee, Berthelot and Grande Allee, Julia and Michael, Julia and D'Artigny, St. Augustin and Julia, St. Augustin and St. Patrick, and in default of said defendants complying with this judgment within said time, the said plaintiffs are hereby authorized to have removed all the said poles and wires at the cost and expense of the said defendants ; and the defendants are condemned to pay to the said plaintiffs their costs, reserving to the plaintiffs their recourse for damages.

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## INSULATION RESISTANCE OF WIREMEN'S GLOVES.

A recent number of the "Bulletin de la Société Internationale des Electriciens" contains a paper read by Janet before the Société in Paris, in which the author gives an account of laboratory experiments performed by him in order to find the insulation resistance of different types of gloves for wiremen The experiments were performed first with the gloves dry and then with them wet, the pressure being 105 volts in each case. In the dry test the gloves were filled with mercury and then suspended in basin of mercury ; fine sand moistened with acidulated water was used. The resistance in megohms ranged from zero to 52,500 dry and from zero to 420 wet. The author also made wet tests for determining the effective e m f at which the gloves broke down under high-pressure alternating currents. Three of the samples broke down at low voltage, while three others broke down at 1,000, 2,000 and 11,000 volts respectively. In the discussion which followed the reading of the paper it was argued that insulating gloves cannot generally be regarded as an effective protection ; and that wiremen with gloves should not touch the conductors directly, but only such parts as are already insulated.

# SYSTEM AND EFFICIENCY OF ELECTRIC TRANSMISSION IN FACTORIES AND MILLS.*

By William S. Aldrich.

The recent progress in the use of electricity for the transmission of power over short distances has developed a new industry. It bids fair to rival in magnitude and usefulness the field of long-distance transmission, much earlier developed, and now almost exclusively held by electricity. As applied to factories and mills electricity is simply a means to an end, which is primarily the transmission of power over quite short distances, from 50 to 500 feet, and within one building or a group of buildings. Upon entering this new field it has had to contest every inch of its progress in competition with long-established usage, in order to displace the unwieldly and unsightly power transmissions by shafting, belting, and rope drives. In almost all cases of new manufacturing plants, however, the features of electric transmission have received thorough consideration, resulting in many factory installations in which this system is exclusively used.

Some manufacturers have hoped that electricity would solve all of the problems, and at once, upon its introduction into their establishments; others have known it would be of no use from the beginning. There are many factories and mills in which the introduction of electricity for power transmission will not pay, under existing conditions; there are more establishments in which it would pay, in which an investment in electric transmission would prove to be a dividend-paying investment. No general rules can be laid down. Each case must be carefully examined, and a most thorough preliminary survey made of all the conditions and requirements.

### SYSTEMS OF ELECTRIC DISTRIBUTION FOR FACTORIES.

In choosing a system of electric transmission for manufacturing work, it is not necessarily best to have that one system which will the most readily lend itself to all of the work to be performed, for light, heat and power service. A composite system may prove best suited, even in such short-distance transmission. That is, lighting service will, in general, be more satisfactory, and need not be more expensive, if supplied independently of the power service. Direct and alternating currents are equally adapted for factory transmission, and by simple or multi-circuit systems of distribution; that is, by two, three, or four-wire systems, as the case may require. Preferably, all distribution should be direct; that is, without the use of storage batteries, rotary converters, or transformers, except for certain lines of work in which it may be necessary to use one or the other of these indirect systems of distribution.

In the matter of voltages a wide range is possible: 110-volt two-wire and 220-volt three-wire systems for use of either direct or alternating currents for light and power; 440-volt two-phase alternating current three or four-wire systems for both light and power; 550-volt direct-current two-wire system, or 550-volt alternating current three-phase three-wire system, chiefly for power service, or the monocyclic system for both light and power. In general, it will not be necessary or advisable to use over 550 volts, direct or alternating current. Shocks arising from accidental contact with wires carrying currents of this voltage are not necessarily dangerous. Experience has shown that workmen respect the distributing wires the higher the voltage. But it is not necessary to command such respect by raising it above 550 volts.

### ELECTRIC TRANSMISSION BY DIRECT CURRENTS.

At the time that electricity was introduced into manufacturing establishments the direct-current system was the only one available. For the peculiar and exacting service required in driving all kinds of machine tools and various workshop appliances, there were difficulties to be overcome with any system. It was necessary to secure satisfactory methods of producing a large starting turning moment, or torque, for varying the speeds as might be required under uniform or variable loads, and for reducing to a minimum the trouble arising from the use of a commutator.

With direct current motors, it was a simple matter to introduce starting boxes (resistances) in the armature circuit to control the torque, as well as rheostats (resistances) in the fields to control the speed in particular. But every such resistance meant an expenditure of energy in otherwise useless heating of the wire or other material of which these resistances might be made. The so-called Ward Leonard system came to the rescue with its two additional machines in order to operate the one given machine as a motor, at practically a constant efficiency under all conditions of load and speed. This system has been very successfully and extensively used in elevators, cranes, etc. By the use of the auxiliary machines the supply voltage may be varied according to the speed desired, and the current supplied according to the torque required, without wasting any energy in heating wasteful resistances. For conditions of factory service permitting of such an application, two motors may be advantageously used on one machine or set of machines, by means of which it is possible to vary the torque and speed quite as satisfactorily as in street car working, by the series-parallel method of control.

The difficulties with commutators have been almost entirely overcome and many refinements in design effected, so that the direct-current motor of to-day leaves little to be desired. Such objectionable features as still remain are inherent in the direct-current system used, and are found to lie chiefly in the kind of armature, commutator and brush devices required. These parts are most liable to derangement, require systematic attention for cleanliness and efficiency and renewals of brushes.

### ELECTRIC TRANSMISSION BY ALTERNATING CURRENTS—INDUCTION MOTORS.

The alternating current system, with its induction motor service, offered practically the only alternative to those engineers and manufacturers who did not care to be troubled with the petty annoyances and delays likely to occur at any time with the direct-current motor. The induction machine as it stands to-day is probably the most perfect motor yet developed from the standpoint of electric transmission in factories and mills. It may be started and operated from any point at any time, at practically any load and speed within its predetermined ranges. It may be used on 110, 220, 440 or 550-volt alternating current circuits of one, two or three phases. It does not require any direct-current supply as the synchronous motor does for its field excitation. It does not require any

*Abstract of a paper read at the Cincinnati meeting of the American Society of Mechanical Engineers.

brushes, commutator or collecting rings. Offsetting these advantages, however, are certain restrictions. The speed of an induction motor falls off slightly as the load is increased. The ability to start an induction motor from rest under a heavy load, as well as the possible speed changes during its operation, are obtained at some sacrifice of efficiency.

Induction motors, moreover, permit of higher lineal speeds than are possible with any other type, from 6,000 to 7,000 feet not being infrequent. By suitable arrangements of its field windings, this type of motor may have its speed altered in regular steps, so reducing it one-half, one-quarter, one-eighth, etc. This makes possible similar changes to gear-wheel combinations, which may therefore be eliminated to the extent that the induction motor is installed to effect such changes. In almost all cases of shop driving, the slip is not objectionable, any more than the increasing slip of the driving belt as the load is thrown on. These motors will stand almost any amount of rough usage and heavy overloads, as they cannot be burned out. If excessively overloaded, the motor slows down and stops, starting up immediately as soon as the load is lightened. Ordinarily, machine tools and almost all classes of shop machinery are started at quite light loads, and the full load is thrown on when the work or the tool is up to the speed desired. For this class of work the induction motor seems specially fitted.

A larger generating power plant is required for an installation of induction motors than would be the case if direct-current motors were used. This is on account of the energy which is lost in all classes of alternating current circuits in which there is considerable self-induction, whether in the transmission wires or in the appliances used. In the case of induction motors this loss is very appreciable at light loads, becoming much reduced at average and heavy loads, at which it is almost uniform.

SYNCHRONOUS MOTORS.

Synchronous motors are admirably adapted to factory service where absolute uniformity of speed is required, and where the extra installation of a direct current supply for their field excitation is not deemed objectionable. While induction motors are always wasteful of some energy, through their high self-induction, synchronous motors may on the other hand be brought into that condition of operation practically equivalent to the use of direct-current motors, at least for a large range of their loads. In other words, the power factor of a synchronous motor may be made almost anything from zero to unity, according to the extent of excitation of its fields by the direct current applied for this purpose.

When made in the revolving field type, synchronous motors are self-starting from rest at light loads. They may be very heavily over-loaded, without falling out of synchronism or out of step, and when they do for an instant they may be brought back again by throwing off some of the load. A well-designed synchronous motor will carry at least three times its full normal load, and not drop out of step. If an induction motor is built for such over-loads it is likely to have quite low efficiency at ordinary loads.

Higher efficiencies may be obtained with synchronous motors than with induction motors of the same output. In fact, such motors realize the ideal conditions of motor working in which the motor attains almost the same efficiency as the generator. Both induction and synchronous motors have usually higher efficiences than direct current motors of same size.

COMBINED INDUCTION AND SYNCHRONOUS MOTOR WORKING.

The ideal conditions in a factory installation no doubt would be secured where both induction and synchronous motors were used, the former for small machines and direct driving, the latter for operating a set or group of machines. The synchronous motors would be started up just before beginning the work of the day, have at all times a light constant load, and might easily be regulated as to produce an almost balanced system in combination with the induction motors. In such a system of transmission the lagging currents of the induction motors would be offset by the leading currents of the synchronous motors, if the latter were operated to produce such leading currents. The whole system would be operated practically throughout quite a range of load variations, as if it were a simple direct current system, the advantage of such a condition is apparent ; it means least installation for any given output, or greatest output for any given capacity of of generating plant. The group method of electric driving is much better adapted for small machines, up to and including 2-horse power capacity, and especially where such machines are in almost constant service. Above this size, individual motor driving becomes more and more efficient, particularly if the machines are operated only a fraction of the day.

## ELECTRIC ELEVATORS.

The electric elevator has gradually won its way to the confidence and favor of architects and building owners, and has recently achieved a marked triumph in being selected to convey visitors to the top of the Washington monument—a sheer lift of 498 feet. The elevator is capable of carrying thirty-five passengers and makes the ascent in five minutes. Its operation is said to be easy. It is at all times under perfect control and is carefully fitted with safety devices. The elevator was made and installed by the Marine Engine and Machine Co., of New York, and is operated from a small power house situated 750 feet west of the monument.

## THE WATER POWERS OF SWEDEN.

A recent report of the Swedish Agricultural Department estimates the available energy of the principal waterfalls in Sweden at from 2,000,000 to 4,000,000 horse-power. It is not stated whether these figures apply only to sites which may be developed at ordinary expense or include all practical water-powers. It is pointed out that the national coal bill for last year amounted to 64,000,000 crowns, and that this sum might be considerably diminished by the employment of the natural motive power possessed by the country.

## THE A. I. E. E.

The American Institute of Electrical Engineers will meet in annual convention in the New York State Building, on the Pan-American Exhibition Grounds, Buffalo, on Tuesday, the 20th inst. Only morning sessions will be held, at which abstracts of papers will be presented on a variety of subjects, including one by Mr. W. S. Aldrich, of Toronto, and Mr. H. W. Redfield, on "Electric Transmission Systems."

## QUESTIONS AND ANSWERS.

Central station manager writes: I am going to put up a three phase transmission line, about nine miles long, carrying [illegible] volts; how often should it be transposed so as to avoid unbalancing of the voltage at the receiving end?

Answer.—If you put your line up in the shape of an equilateral triangle, and your load on all three wires is approximately equal, there will be no need for any transpositions, but if you are likely to have loads very much unbalanced, or if your line is to be strung in any shape but that of an equal sided triangle, you should transpose it twice, one-third of the way from each end.

"Operator" asks: How do you reverse the direction of rotation in a direct current shunt or series motor, and in single, quarter and three phase induction motors?

Answer.—Direct current motors, both series and shunt, are reversed by changing the direction of the current through either the armature or the field; if it be reversed through both simultaneously, that is, if you merely reverse the two leads which supply current to the machine, the direction of rotation will remain the same. Single phase induction motors which are not wound so as to have any definite direction of rotation, will continue to revolve in the way they are first started, that is, without changing any connections they will revolve in either direction, provided they are first started that way by some external means. Quarter phase motors need to have the connections of one phase reversed; reversing the loads to both phases will keep the motor running in the same direction. Three phase motors need to have any two leads interchanged.

"Student" asks: Does it make any difference to a street railway system whether the trolley is positive or negative?

Answer.—It makes no difference whatever to the operation of the cars and plant, though it is usual to make the trolley positive in order to reduce to a minimum the effects of electrolysis on the various water and gas pipes running adjacent to the rails of the system.

J. R., Montreal: What horse power per drill does it require to run an ordinary air compressor for mining work?

Answer. It is usual to reckon on 12 to 14 horse power for each drill, though this figure is somewhat altered by the elevation of the plant above sea level.

Mining Engineer: I am thinking of putting in a transmission plant to supply a mining camp with light and power, and would be glad of your advice as to the best system to use.

Answer.—Without various particulars as to the head of water you have available, the length of your line, the amount of power you want to deliver, etc., etc., it is absolutely impossible to give you any reasonable recommendations as to the plant most suitable for your needs, though generally speaking, we would say that a 40 cycle three phase installation, using direct-coupled generators, would be the one most suited to the majority of cases.

F. T., Toronto: What is the lowest circuit frequency on which arc and incandescent lamps can be run?

Answer.—Arc lamps for out-door use are quite satisfactory on 40 cycles, though for inside work they are somewhat too unsteady. Below this frequency their performance in any situation cannot be considered satisfactory. Incandescent lamps, if of fairly low voltage, and therefore, heavy filaments, give good service at a frequency as low as 40 cycles, though if the use of 220 volt lamps be attempted, there will be noticeable flickering; on the other hand, 52 volt lamps will give fair service on a frequency as low as 30 p.p.s.

R. M. writes: Why are street railway motors always series wound, instead of shunt?

Answer.—Because the shunt wound motor would run when supplied with a given voltage at approximately the same speed irrespective of the load, which would mean that when going up heavy grades the armatures would be overloaded beyond a safe point, also it would not be possible to get a fine shunt winding into as small a space as the series coils will go, due to the extra amount of insulation necessary, and the heating and the chances of trouble would both be increased. Again, the circuit through the motors is often broken for an instant, due to dirt, snow, etc., on the track, and if the motor were shunt wound the field would take so long to come up, due to its large self induction, as compared with that of the armature, that the current through the latter would reach far beyond a safe amount before the field had got any strength; whereas if the motor is series wound, the armature and field currents must be identical.

"R. M.," Vancouver: What is considered to be the ordinary coal consumption per indicated horse power hour for engines running under the conditions which obtain in the usual engine room?

Answer.—The very best results that have been obtained with compound condensing engines show a coal consumption little, if anything, below 1 1-2 lbs. per I.H.P., while on the other hand, there are many plants, which are not considered by their owners to be by any means out of date, whose coal bill will run up to 6 or 7 lbs. We would imagine that any simple non-condensing engine that produced an I.H.P. on 3 lbs. of coal, was giving good service, this figure being reduced by about 10 per cent. if the engine be compounded, a further reduction of 15 per cent. being accomplished by running it condensing as well.

## PAN-AMERICAN EXPOSITION SEARCH-LIGHT SIGNALS TO TORONTO.

Signals from the 30-inch search light, on the electric tower of the Pan-American Exposition, were sent to Niagara Falls on July 25th, by Prof. Geo. F. Sever, Superintendent of Electrical Exhibits, in the presence of the electrical jury, thus demonstrating the feasibility of this method of signalling at night.

Since that time search-light signals have been sent from Buffalo to Toronto, a distance of 58 miles, through arrangements completed by Prof. Sever, in co-operation with Mr. Wm. S. Aldrich, consulting electrical engineer, of Toronto. The first trial was made 9.10 p.m., August 9th, with clouds over Toronto. The local illumination of the overhead sky by the electric arc lights in the streets of Toronto effectually prevented any discrimination being made between the local and the Buffalo illumination of the clouds. The second trial was made 9.50-10.15 p.m., August 13th, with a perfectly clear atmosphere. Owing to the smoke settling down over the city, no signal could be discerned from the top of the municipal hall tower, Toronto. This was the pre-arranged objective point for both experiments.

Special long-distance communication was arranged between the top of this tower and the electric tower at the Pan-American through the courtesy of the Bell Telephone Company, represented by Mr. K. J. Dunstan, of Toronto, so that every detail of the experiment could be followed. The special instructions were to depress the search-light to the lake horizon, bearing on the municipal hall tower, Toronto, then to sweep the horizon a definite angle to the right and left of this bearing, and later to elevate and depress the light at the original bearing. All of these signals were very clearly discerned during the second trial by Mr. C. H. Rust, city engineer of Toronto, with party located on Centre Island, two miles off-shore from the city.

The electric tower of the Pan-American, 390 feet high, is distant 58 miles in an air line from the municipal hall tower, Toronto, 300 feet high. At this distance one degree of arc in the horizontal movement of the search-light would move it across the horizon at Toronto one mile, thus enabling the operator at Buffalo to throw the light to any desired point along the lake front at Toronto. The dip of the horizon at this distance was calculated by the formula used by the Hydrographic Office, U. S. Navy Department, as follows:

Distance in statute miles equals $1.317 \sqrt{\text{height in feet}}$.

The difference in level between Lake Erie and Lake Ontario of 326 feet was also taken into consideration. The true bearing of the Toronto tower from the electric tower was found to be north 25 degrees west.

# ELECTRIC RAILWAY DEPARTMENT.

## ELECTRIC LOCOMOTIVE FOR A PULP COMPANY.

The accompanying illustration represents an electric locomotive recently built at the shops of the Quebec Railway, Light & Power Company, of Quebec city, for the Chicoutimi Pulp Company, of Chicoutimi, Que. It was designed by Mr. Russell, the general superintendent, and is intended for the shunting of regular freight cars about the company's yards, and for hauling the products from the mills to the company's wharves on the Saguenay river

The dimensions of the locomotive are: Length over all, 17 feet; width, 7 feet 6 inches; wheel base, 7 feet 6 inches; gross weight, 43,500 pounds. The frame is very strong and of substantial construction, of oak, with panelling of whitewood. The doors, windows, sashes, etc., are of cherry, and all wood and iron work is nicely finished, painted and varnished

The motor equipment consists of two Westinghouse No 56-55 h.p. motors; gear ratio, 14 68 on 4 1-2 inch axles and heavy 33 inch wheels. The cab contains the following equipment: One G. E. type K 11-S P controller; one Westinghouse automatic circuit breaker; one choke coil; one Westinghouse rotary air pump; one Westinghouse engineers' automatic brake valve; one quick-break switch


ELECTRIC LOCOMOTIVE.

for air motor; one air gauge and automatic pressure regulator; one large air reservoir; and one hand brake.

The locomotive is equipped with Westinghouse automatic quick-action air brakes, with train line connections at each end.

The railway lines of the Chicoutimi Pulp Company consists of about two miles of track having an average grade of 2 1-2 per cent. The only heavy grade on the line is 400 feet of 5 per cent.grade and 39 degrees curvature. In a trial test at the shops of the Quebec Railway, Light & Power Company, the locomotive started and speeded up a train of twelve passenger coaches aggregating a total weight of 255 tons. A speed of about ten miles per hour was accomplished with comparative ease, the current consumption being 100 amperes per motor on start, and 115 amperes per motor on speed. The wheels skidded at 160 amperes per motor, with an equivalent draw-bar pull of nearly 8,000 pounds, or one-fifth of weight on drivers.

Through the kindness of Mr. D. E. Blair, we may at a later date give some details regarding the operation of the locomotive.

Mr. Charles Tessareau, for twenty-six years in the employ of the G.N.W. Telegraph Company at Montreal, has been appointed chief of police at Lachine, Que.

## EFFECT OF TEMPERATURE IN RAIL MAKING.

It has for years been known to all rail makers that bars finished at reduced temperatures yield a better service than those turned out at the former high temperatures, and we notice that the Pennsylvania Railroad Company specified in its contracts this year that the rails must be finished at a low heat Mr R. W Hunt, of the above railway, states that under the old conditions the temperature at which sections of rails at 80 lbs per yard were finished in most rail mills averaged 1,795 degs Fahr., as observed by the "Lunette" pyrometer The following observations have been made under existing conditions, in altered rolling mills, on 80 lbs. per yard and some lighter rail sections - Temperature of partially formed rails when first placed on cooling table, 1,742 degs., 1,772 degs., 1,772 degs., 1,742 degs., 1,772 degs., 1,772 degs., average, 1,762 degs. Fahr. The temperature of finished rails on leaving the rolls averaged 1,580 degs Fahr The rails remained on the cooling table for periods varying from 1 min 6 sec. to 1 min 20 sec It was found that the saws, to yield a rail of 80 lbs. section, 30 feet long, had to be set quite 1 inch nearer together than under the old practice

## TESTS OF TROLLEY WIRE.

Mr. A L. C. Fell, in a recent paper descriptive of the equipment of the Sheffield electric railway system, mentions the fact that of late the British manufacturers of copper wire have greatly improved the quality of their product He also refers to the satisfactory results obtained from the use of a patent trolley wire known as Phono-electric, as follows.—

"So far excellent results have been obtained, the only disadvantage being that the conductivity is only about 50 per cent that of pure copper, but it only means a little more copper in the feeder cables to make up for the loss in the trolley wire, and this is as nothing in comparison to the benefit derived by having the number of broken trolley wires reduced to a minimum On the average, it was found that the Phono-electric trolley wire gave about 50 per cent. greater tensile breaking strength and withstood about 2 1-2 times the torsion breaking strain of good, hard drawn copper The accompanying table gives the results of a comparative test made on hard-drawn copper and Phono-electric trolley wire:

| Sample | Original Dimensions | | Length Inches | Elongation Inches | Stress Tons | | Twist in [illegible] inches |
|---|---|---|---|---|---|---|---|
| | Diameter | Section | | | Total | Sq In | |
| Phono-electric | 0.324 | 0.082 | 10 | 0.35 | 2.07 | 36.22 | 34.0 |
| Copper........ | 0.324 | 0.082 | 10 | 0.23 | 2.05 | 24.86 | 13.5 |

## PUBLICATIONS.

Messrs. Thos. Andel & Co., 63 Fifth avenue, New York, are the publishers of a new book called the "A B C of the Telephone," a practical treatise on the construction and operation of telephonic apparatus, circuits and exchanges. The subject of private intercommunicating telephone systems is also fully treated, being illustrated with diagrams of wiring, containing descriptions of the most practical switching devices, and numerous representations of specially constructed apparatus.

Herr Rathenau, the manager of the Berlin Electrical Works, has informed the German Emperor that a number of prominent German financiers and banks, in conjunction with Messrs. Siemens and Halske, the Allgemeine Elektricitats-Gesellschaft, the firm of Friedrich Krupp, of Essen, and others have formed a syndicate to study the problem of working a "lightning" railway from Berlin to Zossen. By its means it is hoped to attain a speed of from 125 to 160 miles an hour with electric cars, one of which is already being built by the Allgemeine Elektricitats-Gesellschaft, and the other by the firm of Siemens Halske.

# ENGINEERING and MECHANICS

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

THE ANNUAL CONVENTION.

The delegates appointed to represent the various branches at the coming annual convention of the Canadian Association of Stationary Engineers are looking forward to a pleasant and profitable time. The convention will be held in Brantford on Tuesday and Wednesday, August 20th and 21st. The opening session will be held at 11 a.m., when the delegates will be welcomed by the civic authorities. In the afternoon there will be a business session until 4 o'clock, when the delegates and visitors will be given a drive, through the courtesy of the Waterous Engine Works Company. At 8 p. m. there will be an open meeting, at which papers on engineering topics are expected to be read by Messrs. E. J. Philip, A. M. Wickens and Charles Moseley.

The greater part of the second day will be taken up by business sessions, and in the evening the annual banquet will take place. The members at Brantford are putting forth their best efforts to make the convention a success from a social standpoint. The executive officers of the C. A. S. E. are: G. C. Mooring, Toronto, president; Charles Moseley, Toronto, vice-president; A. M. Wickens, Toronto, secretary; W. Oelschlager, Berlin, treasurer; George Dawson, Hamilton, conductor; James Dixon, Toronto, doorkeeper.

HAMILTON NO. 2.

The annual outing of Hamilton Branch No. 2 C.A.S.E. was held on the evening of July 31st on the beautiful steam launch "Ampere," owned by Bro. Allen Marshall. The trip across the bay and out into the lake was very pleasant; the moon was in her glory, shining over the waters, and every person enjoyed themselves. The main feature was no ladies were allowed on board. Mrs. Marshall sent an abundant supply of refreshments. The engineers exhausted their energy in singing. Bro. Morris, in his fine voice, gave two songs, and Bros. Ironside, Dawson and Chub rendered a trio with a chorus "When we Go to Brantford." A hearty vote of thanks was tendered Bro. Marshall and Mrs. Marshall.

At the annual installation a short time ago Ald. R.C. Pettigrew was installing master. A feature of the meeting was a presentation of a handsome umbrella to Bro. James Carroll, the retiring financial secretary.

## INSTRUCTIONS FOR SETTING UP, OPERATING AND MAINTAINING STATIONARY BATTERIES.

A catalogue recently issued by the Gould Storage Battery Company, Depew, N. Y., contains the following rules and instructions for batteries, which are well worth reproducing.

1. Unpack the cases carefully, opening them from the marked side, and clean elements and containing cells (glass jars, rubber cells or lead lined wooden tanks, as the case may be).

2. In moving elements, always lift them by both top bars.

3. Place cells in desired position, leaving a space of about one inch between jars on battery stands, which should be erected in a cool, accessible place, where they will not be exposed to dust or dampness.

4. Scrape lead connecting lugs and connect up, being careful to join adjacent cells in series; that is, positive to negative. The positive plates are stamped P or +, and are of a dark brown color, while the negatives are of a dark gray. Screw connecting bolts or binders up tightly.

5. The acid solution should be mixed one day before it is wanted for use, to allow it to cool. Under no circumstances fill cells with warm acid. The acid solution should have a strength of twenty-five degrees Baume, which should be maintained at all times when cells are fully charged.

6. If current for charging be available, acid solution may be poured in the containing cells, one-half inch above plates, but do not fill cells unless they can be connected to the charging circuit at once.

7. Immediately after filling cells, connect charging current and charge at one-half normal rate for four hours, then increase to normal rate, and charge for about twenty hours.

8. Before closing circuit, be sure that the dynamo positive is connected to battery positive, and dynamo negative to battery negative, and that the voltage of the dynamo is 10 per cent. higher than the battery voltage.

9. At the end of the first charge, each cell should read 2.7 volts, and gas should be given off freely, the solution assuming the appearance of boiling.

10. Subsequent charging should be stopped when voltage is 2.6 volts per cell and gas is given off.

11. Discharge should be stopped and cells immediately recharged when voltage is down to 1.8 volts per cell when discharged at normal rate.

12. Always keep the plates well covered with the electrolyte acid solution.

13. Exclude all dirt, metallic particles or foreign matter from the cells.

14. Test cells individually at regular intervals with both hydrometer and cell tester. Should any cell read low, cut it out of circuit for one discharge (thereby giving it an extra charge.) If this does not bring it up to the proper condition, disconnect, take it apart, lifting the element from the jar by grasping it firmly by both cross bars, and wash it well, removing with a stick any foreign material which may adhere to the plates; attend to a low reading cell at once; do not wait.

15. Go over all connections regularly, and see that they are kept clean and tight.

## STEAM ENGINE SPECIFICATIONS.

The Engine Builders' Association of the United States has submitted for the consideration of architects and engineers the following suggestions in connection with specifications for the installation of steam engines:—

(1) That contracts which provide a penalty for failure to deliver in time or for failure to meet guarantee ought also to provide equal premiums for earlier or better results than specified. (2) That bonds should not be required on installation contracts unless corresponding bonds for similar amounts are given to secure payment. An exception always being made in the case of government, state or municipal contracts. (3) That settlements or any part of them ought not to extend beyond three months from completion of contract, and that delay on the part of the owner ought not to delay payment beyond a reasonable time. (4) That a guarantee against defective material or workmanship should not be made to cover a period of more than one year from date of shipment. (5) That purchasers of engines ought not to be furnished with complete working drawings, but simply with general drawings, showing the assembled engine in outline, with such principal dimensions as will answer for building foundations, the erection of engines or their care.

## EFFICIENCY OF THE GAS ENGINE.

At the recent meeting in Milwaukee of the American Society of Mechanical Engineers, a paper was presented by Mr. C. H. Robinson, in which were given the results of efficiency tests of a 125 h.p. Westinghouse gas engine. The average thermal efficiency of the engine was 20.05, the highest being 23.24 per cent; the figures correspond to 171.66 and 226.13 B.T.U. per indicated horse-power-minute, respectively. The mechanical efficiencies corresponding to these tests were 79.39 and 89.05 per cent. respectively. Tests were made to determine the distribution of heat in the engine. At the lowest horse-power of the series 10 per cent. was accounted for by the indicator, 32 per cent. went out in the exhaust and 58 per cent. in the jacket water. At the highest horse-power (164 indicated) these figures became 26, 44 and 30 per cent, respectively.

Under the title "Electrical Designs," the American Electrician Company, of New York, have recently published a book of 260 pages. Instructions are given for constructing small motors, testing instruments and other apparatus, accompanied by working drawings for each design.

## BOILER EXPLOSIONS.

An exhaustive report published by one of the leading boiler inspection companies in New England states that the total number of boiler explosions during last year in the United States was 373, as against 383 in 1899. There were in all 268 persons killed as a result of these explosions, against 298 last year, and 520 injured, against 456, making a total of 788 killed and injured, as compared with 754 the previous year.

Officials of boiler inspection companies find it difficult to account for the fact that boiler explosions in the United States are so much more numerous and destructive than those in Great Britain, where the total number of those killed and injured was only 89 last year.

The average number of explosions in the United States exceeds one a day, and inspectors say that the ratio of boilers to those in use in Great Britain show nothing approaching these casualties in comparison.

No explanation of this disparity can be vouchsafed. The president of one of the largest companies in the country says that after much investigation he is utterly unable to offer any solution of the problem which appears to be reasonable and adequate.

## BOILER INSPECTION IN MONTREAL.

The city boiler inspector has completed his report for 1900. It shows the following inspections, etc., were made during the year:

Inspection of steam boilers—Visits of inspection, 1410; internal and external inspections, 763; hydraulic tests, 426; hydrostatic tests, 33.

The results of these visits were as follows: Boilers condemned as unsafe, 6; boilers found imperfect, 137; boilers erected during the year, of which five were second-hand, 48; notices of inspection served, 256; certificates issued, 417.

Candidates for engineers' certificates—Certificates issued to 448; failed to pass examination, 37. Total 486.

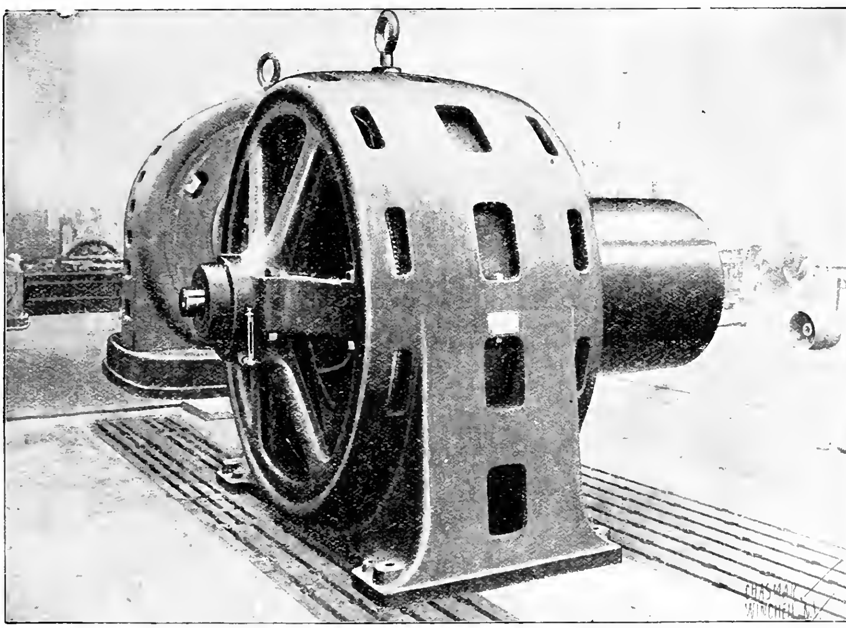
There were fewer boilers erected the past year than in 1899, but their capacity of horse-power is greater.

The new century opens with a clean record as regards any boiler explosions during the existence of the department, namely, 21 years.

## WESTINGHOUSE MOTORS.

The illustration herewith represents an induction motor manufactured by the Westinghouse Electric & Manufacturing Company, several of which are in operation in the works of the E. B. Eddy Company at Hull, opposite Ottawa. The motors are used for driving pulp and paper machinery, and are supplied with current from the Deschenes Rapids, seven miles above the Eddy Company's works. The motors were furnished and installed by Ahearn & Soper, Limited, the aggregate capacity installed in the Eddy works being 1,500 horse power.

Some 4,500 horse power in capacity of the same type of motors have been installed by Ahearn & Soper, Limited, in the mills of the Dominion Cotton Mills Company, and the Montmorency Cotton Mills Company, Montmorency. The same firm has installed a number at the Magog Cotton Mills.



TYPE OF WESTINGHOUSE THREE-PHASE MOTOR INSTALLED BY AHEARN & SOPER FOR E. B. EDDY COMPANY, HULL.

Montreal Branch No. 1, Canadian Association Stationary Engineers, at its last regular meeting at 1863 Notre Dame street, elected these office-bearers for the year: President, J. G. Murphy; first vice-president, H. Wadey; second vice-president, H. J. Weaver; treasurer, Thos. Ryan; recording secretary, Wm. Smythe; corresponding secretary, H. Marchand; financial secretary, H. Nuttall; doorkeeper, H. Knight; conductor, Alex. Adams; librarian, W. Ware; trustees, Geo. Hunt, W. Ware and F.H. Thompson.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,
MONTREAL, AUGUST 5TH, 1901.

Montrealers enjoy cheap light, and from recent advertisements in daily press, it seems that the Lachine Company are determined to keep us protected, as they state they will meet any cut rate the new combine offer. Up to date the Lachine Company strenuously deny that they will enter the combine, but money tells, and all things are possible.

The Power, Heat & Light Company (Royal Electric) are busy pulling down old houses and clearing away generally on the property lately acquired, with a view to pushing through the new sub-station which is required owing to their additional requirements.

A few years ago the National Board of Fire Underwriters "kicked" at the grounding of the neutral wire in the three wire system. Now, if al, stories be true, they permit it. If so, it would seem that some of the regulations are jotted down with insufficient forethought.

The practice of college professors accepting fees for outside consultations, etc., is being discussed by one of our foremost engineering societies. Some are of the opinion that such practice is unfair and should be frowned down.

Fifty two volt is evidently "doomed"; in fact, fan motors and other accessories for such are now dubbed old style. The call for apparatus of that voltage is gradually becoming less and less, and 104 and 110 is rapidly replacing it. Probably it will not be many years until 220 is replacing these latter. It is the non-applicability of the fittings at present on the market which retards this advance, more than the factor of the inefficiency of the 220 volt lamp.

One of the prettiest residential spots on the island of Montreal is on the slope of the little mountain in the suburb of Wettmount. Unfortunately, however, the residents of that locality are frequently treated to volumes of dense black smoke from the chimney of the upper level pumping station, the property of the Montreal Water Power Company. We are given to understand that the engine will shortly be replaced by an electric motor, which not only will be a source of greater comfort, but will probably enhance the value of property in the district. It is said that the motor will be from the works of the Bullock Electric & Manufacturing Company, which firm have lately completed a contract for press driving motors for the Montreal Daily "Star."

The Montreal Park & Island Railway has been virtually taken over by the Montreal Street Railway to the benefit of the citizens generally and to those in the surrounding municipalities. The M. P. and I. Ry. has been a sort of one horse concern from its conception, blocking the M. S. Ry. from getting right of way in municipalities where they could have run belt lines in connection with their city service and giving an infinitely superior service. Notably in the municipality of St. Louis de Mile End there has been quarreling between the M.P. & I. Ry. and the municipal authorities, also the municipality of Outremont have been "kicking." Already the evidence of more progressive management is seen in the Mountain Belt Line, which goes right around without change and which was a perfect god-send to many during our hot spell.

## OLD-TIME TELEGRAPHERS' ASSOCIATION.

The twent-first annual re-union of the Old-Time Telegraphers' Association and the Society of the United States Military Telegraph Corps will be held in the city of Montreal, on September 11th, 12th and 13th. Mr. L. B. McFarland, of the Bell Telephone Company, Montrea,, is president of the Old-Time Telegraphers' Association, and Mr. J. Hutcheson, of the Ottawa Electric Railway Company, vice-president.

The following programme has been arranged:

Wednesday, September 11.—10.00 a. m.—Meeting of O. T. T. A. and U. S. M. T. C. in the Ladies' Ordinary, Windsor Hotel. Address of welcome by his Worship Mayor Prefontaine, M. P. 10.30 a. m.—Business Meeting, O. T. T. A. The "Telegraphers' Home" project will be brought up for discussion and a proposition to merge the "Telegraphers Historical Society of North America" will be considered. 11.30 a. m.—Business meeting of U. S. M. T. C. in the Ladies' Ordinary, Windsor Hotel. 2.00 p m.—Drive through the city and up to the summit of Mount Royal. Thursday, Sept. 12. —10 30 a.m. —Visiting Electrical Buildings. 2.00 p m.—Trip on steamer "Duchess of York" via the Lachine Canal; Shooting the rapids and inspection of the harbor of the city of Montreal. 8.00 p. m.—Theatre party. Friday, September 13 —2.00 p. m —A trip by trolley cars and visit to the power plant of the Lachine Rapids Hydraulic and Land Company. 8.000 p. m.—Subscription Banquet, to be held at the Windsor Hotel.

## BY THE WAY.

In point of extreme brilliancy the acetylene gas exhibit at the Pan-American Exhibition takes first place, but for beauty of illuminating effects, the management depend upon the incandescent electric lamps, 40,000 of which are in use on the electric tower. The effect produced by these lamps is the most beautiful that has ever been attained by any method of artificial illumination. Regret is expressed by visitors interested in electricity that no opportunity is afforded them of examining the Nernst lamps, which are in operation in the electricity building. These lamps are hung in an inconspicuous position, high up beneath the ceiling.

* * *

Toronto can now boast of having an automobile club, with a membership of twenty. Every Thursday evening the club assembles for a "run" over a pre-determined route. The vehicles are propelled by various methods—electricity, steam, gasoline, etc., and are fitted with lamps. They form an interesting and thoroughly up-to-date procession, and attract a full measure of attention en route. Toronto, with its comparatively level and well-paved streets, is well adapted to horseless vehicles. The number of vehicles, both for pleasure and business purposes, is rapidly increasing.

* * *

The experience of Mr. R. F. Hayward, chief engineer of the Utah Light and Power Company, of Salt Lake City, is, that in pole planting a liberal application of salt around the pole while the dirt is being filled in and tamped, is the best method which can be adopted to prevent decay. I think I hear somebody in a stage whisper remark "Cum grano salis." But why shouldn't salt as efficiently preserve an electric light pole as a side of bacon? We are not told what quantity of salt per pole is required, therefore cannot judge whether or not the cost would be prohibitive. The experiment might easily have been tried here a few years ago, when American salt was selling on this market at 85 cents per barrel (and at $3.50 per barrel in Chicago). Since then, however, the manufacturers have formed a combine and are no longer cutting each others throats, consequently the price of the preservative has "riz."

## MOONLIGHT SCHEDULE FOR AUGUST.

| Day of Month. | Light. | Extinguish. | No. of Hours |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | " 7.00 | P.M. 9.30 | 2.30 |
| 2 ... | " 7.00 | " 10.10 | 3.10 |
| 3.... | " 7.00 | " 11 00 | 4.00 |
| 4.... | " 7.00 | " 11.45 | 4.45 |
| 5.... | " 7.00 | " 0.40 | 5.40 |
| 6.... | " 7.00 | " 1.40 | 6.40 |
| 7.... | " 7.00 | " 2.45 | 7.45 |
| 8. .. | " 6.45 | " 3.45 | 9.00 |
| 9.... | " 6.45 | " 4.45 | 10.00 |
| 10.... | " 6.45 | " 4.45 | 10.00 |
| 11.... | " 6.45 | " 4.45 | 10.00 |
| 12.... | " 6.45 | " 4.45 | 10.00 |
| 13.... | " 6.45 | " 4.45 | 10.00 |
| 14.... | " 6.45 | " 4.45 | 10.00 |
| 15.... | " 6.30 | " 5.00 | 10.30 |
| 16.... | " 6.30 | " 5.00 | 10.30 |
| 17 ... | " 6.30 | " 5.00 | 10.30 |
| 18.... | " 7.40 | " 5.00 | 9.20 |
| 19.... | " 8.30 | " 5.00 | 8.30 |
| 20.... | " 9.15 | " 5.00 | 7.45 |
| 21.... | " 10.15 | " 5.00 | 6.45 |
| 22.... | " 11.10 | " 5.10 | 6.00 |
| 24.... | A.M. 0.10 | " 5.10 | 5.00 |
| 25.... | " 1.15 | " 5.10 | 3.55 |
| 26.... | " 2.30 | " 5.10 | 2.40 |
| 27.... | No Light. | No Light. | .... |
| 28.... | " | " | .... |
| 29.... | " | " | .... |
| 30.... | P.M. 6.15 | A.M. 9.00 | 2.45 |
| | | Total........... | 187.40 |

## SPARKS.

The Cranbrook Electric Light Company, Limited, of Cranbrook, B.C., has been incorporated.

The United Electric Company, Limited, of Toronto, has been authorized to increase its capital to $300,000.

Negotiations are still in progress for the extension of the St. Thomas street railway to Port Stanley, Ont.

It is rumored that the capital has been secured for an electric railway between Cornwall and Trenton, Ont.

The town of Lindsay is reported to have given the contract for the town lighting to the Burgess Gas Company, of Toronto.

The town council of Perth, Ont., is about to make an offer to the Perth Electric Light Company for the purchase of its plant.

The Ottawa Electric Company purposes building a new distributing station on the canal reserve near the site of the new driveway.

The authorities of St. Catharines, Ont., are asking for tenders up to August 15th for lighting the streets of the city by arc lamps.

The Metropolitan Railway Company, of Toronto, have begun the construction of a branch of their railway from Bond Lake to Schom erg.

The Halifax Electric Tramway Company have been awarded the contract for lighting the streets of Halifax, N.S., for a period of five years.

On August 16th the ratepayers of Collingwood, Ont., will vote on a by-law to raise $10,000 for the improvement and extension of the electric light plant.

Mr. M. G. Cameron, of Goderich, Ont., will apply for the incorporation of a company to build an electric railway from Goderich to Kincardine and Southampton.

The plans of the Fort Erie Fesry Electric Railway, running along the west side of Niagara river from Chippewa to Fort Erie, have been submitted to the Minister of Public Works for approval.

The West Kootenay Light & Power Company, of Rossland, B.C., are said to have offered $50,000 for the electric light plant of the city of Nelson, B.C., and have made a proposition to light the city.

The British Columbia Electric Railway Company are installing new boilers in their power house at Vancouver. The work is being done under the superintendence of the chief engineer, Mr. K. G. Dunn.

The Renfrew Power Company, of which Mr. Thomas A. Low is secretary, have asked for tenders for construction of dam, flume and power house in connection with proposed water power development.

The town of Mount Forest are considering the advisability of purchasing the electric light plant. It is being valued and reported on by Mr. H. F. Strickland, of Toronto, but the deal has not been closed.

The Canadian Pacific Railway Company are considering the substitution of electric for steam power for hauling their trains in the high mountain grades of the Rockies, where there are immense water powers.

A dispatch from Norman, Ont.,says: A large number of men will be employed setting up poles, stretching wires and erecting buildings at the dam for the transmission of 6,000 horse power of electricity to Winnipeg.

A complete electric light plant will be installed for lighting the proposed beet sugar factory at Wallaceburg, Ont. The contract for building the factory has been given to the Kilby Manufacturing Company, of Cleveland, Ohio.

The Bsockville Recorder says concerning the municipal plant at Morrisburg, Ont.: "The electric light and power plant is getting on very slowly. It was to have been running last December, and it is an open question if it will be completed this coming December."

Mr. E. R. Woods, of the National Trust Company, Toronto, states that a Boston syndicate have recently bought the ferries running between Sydney and North Sydney, N.S., and the Sydney electric light plant, and will construct an electric railway between Sydney and Glace Bay, at a cost of $750,000.

The Cascade Power Company has commenced the work of building a pole line between Cascade, B.C., and Phoenix mining camp. At least 10,000 horse power, it is said, will be developed. The dam at the head of the falls on Kettle River is nearing completion, but the power house has not yet been erected.

Messrs. Alexander Fraser, W. C. Edwards, M.P., and other lumbermen of Ottawa, who have secured a franchise of the water power at Table Rock, on the Quebec side of the Chandiere Falls, expect to develop 10,000 horse power, and will supply electric energy to the Consumers' Electric Company.

The Canadian Niagara Power Company have appointed Mr. Cecil B. Smith, of the firm of Smith & Aldrich, of Toronto, to be resident consulting engineer of the power development work to be carried out on the Canadian side. It is said that competitive proposals for the wheelpit contract will be invited immediately.

The Citizens Telephone & Electric Company, of Rat Portage, Ont., have asked for an injunction to restrain the town council from passing a by-law regulating the rates the company may charge for light. The company claim that under the existing agreement the council have no right to interfere at the present stage.

Mr. Barlow, employed by the Lachine Rapids Hydraulic & Land Company, Montreal, met his death last week while repairing the company's wires. He accidentally touched a live wire and was rendered unconscious. His body became entangled in the wires and before it could be removed was terribly burned, resulting in death in a short time.

It is reported that the Keewatin Power Company, of Keewatin, Ont., is taking tenders on the development of a water power at the outlet of the Lake of the Woods, it being the announced intention to install a plant capable of developing 6,000 horse power, most of which, it is said, will be transmitted to Winnipeg. According to the Winnipeg Free Press, it is the intention to construct two transmission lines so as to guard against interruptions from break-downs.

The nature of sound is explained in very simple language in the following inscription on Everett's model, 1863: "Silence in action is sound in motion. Sound and silence, then, belong to the order of dual substance in unity. This 'phonic unity I have discovered and demonstrated to be an independent imponderable phonic cystoplastic suisysmoris, which cannot be divided or destroyed. It resides in all non-metallic atoms, which not only part with it, but transmit, reverberate and absorb it."

U. S. Consul-General Mason at Berlin has found it necessary to forward to the State Department a correction of very generally published statements to the effect that new electric trains have been running at the rate of 125 miles an hour between Berlin and Hamburg. Mr. Mason says that a series of high speed trials are to be made on an 18-mile line between Berlin and Zossen, aided by the German Government, in August and September, which will attract the electricians of the world. The greatest electrical house in Germany has built a special motor car, which is to run in competition with one made by one of the leading American concerns for this special test.

The Toronto Star says:—"A new game has been introduced into the city—invented here, because it is not known to be played elsewhere. Its only implement is any ordinary electric fan. The four flanges of the fan are marked, and each player puts up a sum of money to support his belief that his particular flange will stop at the top when, the power being turned off by means of the switch, the fan of its own accord stops revolving. There are four flanges on most ordinary fans, and this easily allows four

players to bet at one time. Fewer than four can also play. Some people may recognize a similarity in principle between this game and roulet. But it is much more easily played."

The Hamilton Radial Railway Company have made arrangements for the extension of their line from Burlington to Oakville, and agree to have cars running to that town before June 1st, 1902.

At the third annual meeting of the Toronto Railway Electricians' and Mechanics' Benevolent Association, Mr. M. Power, master car builder, was elected president; S. Potter, chief electrician, vice president; and G. Sweetlove, recording secretary.

Messrs. J. Wylie, A. G. Smith and John Boyd have formed a company to install an electric power plant at Whitehorse, B.C. The plant will be supplied with high-speed engines and two Westinghouse dynamos of 700 light capacity.

The Imperial Electric Light Comoany held their annual meeting in Montreal recently and declared a dividend of 7 per cent. Officers were elected as follows: V. Morin, president; Rod. Tourville, vice-president; Dr. Chagnon, treasurer; and Mr. Chapleau, managing director.

When the Duke and Duchess of Cornwall go out from Quebec to see the Montmorency Falls they will travel in some of the finest electric cars in America. The Ottawa Car Company has received an order for four special cars to be used for the first time when the Royal visitors are in the Ancient Capital. The Ottawa Car Company will make the cars as elegant as possible, and they will be models of beauty and unsurpassed by any in America. The cars will be open, and plate glass will be freely used, while the fittings will be of bronze.

The village council of Marmora, Ont., are considering the question of street lighting.

The Prince Edward Island Electric Light Company have been given a contract for the electric street lighting in Montreal for three years.

Arrangements have been made whereby the Hull and Aylmer electric cars will cross the interprovincial bridge between Hull and Ottawa, and in exchange for this privilege the Pontiac and Pacific Junction cars will run on part of the Hull & Aylmer Company's tracks.

## THE OTTAWA ELECTRIC COMPANY.

The annual meeting of the Ottawa Electric Company was held in Ottawa last month, at which satisfactory reports were presented. The report of the directors showed that the gross receipts of the past year had been \$196,363.22, an increase of \$19,680.93 over the previous year. The gross expenditure was also greater, being \$36,558.91 in excess of the amount expended last year. This was owing to the heavy losses sustained in the big fire, in which four of the company's power houses were burned, necessitating the operation of a steam plant to the fullest extent.

The number of incandescent lights now installed by the company is 93,207, which is an increase of 6,093 during the year. There have been increases in all other branches of the service and the total number of customers of the company is at present 5,208.

A resolution was passed setting forth the high appreciation by the directors of the services rendered by the president, Mr. T. Ahearn. Directors were elected, and at a subsequent meeting Mr. Ahearn was re-elected president, and Mr. F. P. Bronson vice-president.

CANADIAN

# ELECTRICAL NEWS

AND

## ENGINEERING JOURNAL.

VOL. XI. SEPTEMBER, 1901 No 9.

## EXHIBIT OF THE CANADIAN GENERAL ELECTRIC COMPANY.

To enter the Machinery Hall at the Toronto Industrial Exhibition was to admire the exhibit of electrical apparatus made by the Canadian General Electric Company. This was the first time in several years that the company have exhibited at the Toronto Exhibition, special arrangements having previously been made at their warerooms for the reception of visitors. Their exhibit this year was a valuable addition to the display in the Machinery Hall. It was located on the south side of the hall, where a pavilion had been built 120 feet in length. The names of the Canadian General Electric Company, and its associate company, the Canada Foundry Company, were attractively brought out in gold lettering on white background. The display of electrical apparatus ranged from the 150 k. w. S. K. C. generator to the 1½ k. w. 1 B. direct current generator; from the enclosed arc lamp to the miniature incandescent lamp. There was shown a 25 light constant current transformer, forming part of a complete system of series alternating current enclosed arc system of street lighting. The current was brought into the blue Vermont marble switch-board and thence to the transformer at 2,200 volts and then to the enclosed arc lamps hung about the exhibit. The effect produced when the lamps were lighted was most attractive and pleasing, and was the subject of much comment by visitors to the Machinery Hall. One of the C. G. E. type H. generators in operation was also shown, the current being utilized for incandescent lamps, fan motors, etc. A motor driving a sewing machine and electric cooking and heating apparatus of great variety were likewise exhibited, as was also a street railway truck made by the Canada Foundry Company and equipped with two G. E. 1,000 railway motors, while there were also some K controllers and other car equipment. Sample boards of supplies were arranged as four-sided pyramids on a pivot. The display also included a full range of lighting transformers from the smallest size to 10,000 watts, three massive air blast transformers, and almost everything in the line of electrical apparatus and supplies. The accompanying illustration will serve to show in a measure the general arrangement of the exhibit.


EXHIBIT OF THE CANADIAN GENERAL ELECTRIC COMPANY AT TORONTO EXHIBITION.

## ROTARIES VS MOTOR-GENERATORS.

An interesting comparison of the relative efficiencies and cost of static transformers and rotary converters as against motor-generators receiving the 11,000-volt current direct into the motor, and converting it into 600-volt direct current by means of a generator coupled to the same shaft, is given in the following table, which is due to H. G. Stott, electrical engineer of the Buffalo General Electric Company:

EFFICIENCIES: 200-KILOWATT UNITS.

| | Transformer. | Rotary. | Combined. | Motor. | Generator. | Combined. |
|---|---|---|---|---|---|---|
| Full load ......... | 97.5 | 93.0 | 90.67 | 95 | 92 | 87.4 |
| ¾ load ......... | 97.1 | 92.5 | 89.81 | 94 | 91 | 85.54 |
| ½ load ......... | 96.0 | 90.0 | 86.40 | 92 | 88.5 | 81.42 |

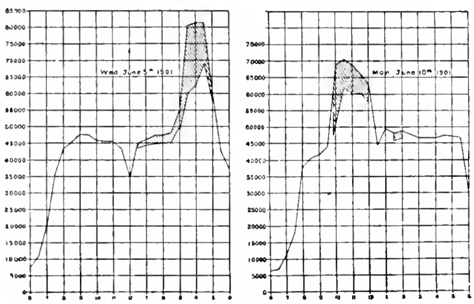
From the above table it will be seen, says the Journal

of Electricity, that the transformer and rotary converter give 3.27 per cent. at full load, 4.27 per cent. at three-quarter load, and 4.98 per cent. at one-half load better efficiency than the motor-generator set.

The investment shows a saving in favor of transformers and rotary converters of about 19 per cent., so that for purposes such as railroad work, where no great refinement of regulation is required, the rotary is beyond doubt the best and most economical.

## STORAGE BATTERIES IN CENTRAL STATIONS.

Among the many problems which confront the manager of a central lighting station, one of the most troublesome, especially during the summer season, is that which is caused by the sudden load thrown on the station by a thunderstorm—the overcast sky causing thousands of lights to be turned on for a period of from half an hour to possibly several hours. This creates a peak for which no preparation has been made, necessitating firing up an extra boiler and starting additional generating units—all of which takes considerable time




FIGS. 1 AND 2.—CURVES SHOWING OPERATION OF BATTERY.

and possibly by the time steam is generated, the storm has broken, and the necessity for extra work has passed.

In no way can the usefulness of an installation of chloride accumulators be better shown, says the Electrical World, than in just such an emergency load, and the accompanying diagrams, which show their operation in the battery stations at the Chicago Edison Company on a dark day, are striking illustrations of the manner in which the battery "helped them out."

Fig. 1 is a curve showing the operation of the battery on June 5, 1901, and Fig. 2 that of June 10. Both of these curves show in the shaded portions the work done by the battery.

## BY THE WAY.

The Great Northwestern Telegraph Company, of Toronto, are to be congratulated upon having succeeded in reaching an agreement with the city of Toronto, under which the amount of the assessment to be imposed on their property has been fixed for all time to come.

* * *

The firm hold that electric lighting has obtained on public favor is exemplified by the fact that in a number of the new dwellings now being built in Rosedale and other choice residential districts of Toronto, no gas-piping for lighting purposes is being put in. A single gas-pipe entering from the rear suffices to give the supply required for cooking purposes.

* * *

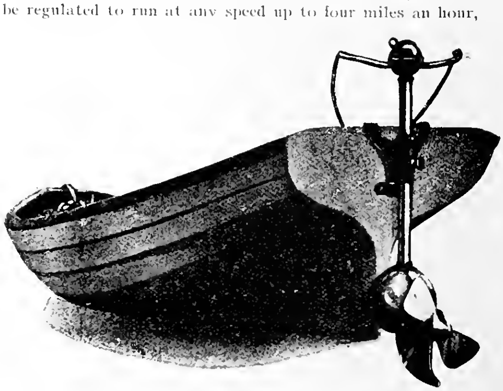
I am sometimes amazed at the character of the devices offered as substitutes for the electric light. While at the Toronto Industrial Exhibition my attention was attracted by a man with a large foot pump strenuously at work pumping air into a tank enclosed in the base of an ornamental iron lamp-post, from the top of which depended a glass street lamp. The contrivance was labelled "The Meriden Hydro Carbon Arc Light." I learned that the tank into which the air was being pumped also contained gasoline, and that the pumping-up process (which, by-the-way, appeared to be the hardest kind of work) had to be resorted to every 24 hours. I pictured to myself a town fitted with an outfit of this character, with a foot pump brigade to keep it in operation, and imagined how it would become the laughing stock of its neighbors, equipped with up-to-date electric lighting plants, with which it is only necessary to press the button to perfectly illuminate the streets, business places and residences. Until better substitutes are obtainable than those which are now offered, the electric light will continue to increase in popularity.

## SUBMERGED MOTOR FOR ELECTRIC BOATS.

A small portable electric motor for propelling small boats is the novel device that is being manufactured by the Submerged Electric Motor Company of Menomonie, Wis. This propeller, says the Electrical World, as a combination of motor, propeller-wheel and rudder is occupies the place of the rudder, as shown in the accompanying illustration, and can be placed in position on any boat and exchanged from one to another in a very few complete and portable, weighing but 35 pounds. It minutes.

The motor itself is under water, while the storage batteries are in such compact form that they may be placed out of the way, under the seats of any ordinary rowboat. The motor not only propels the boat, but steers it as well, the boat answering to it more readily than to an ordinary rudder. It is simple in construction, and is not liable to get out of order, it is said.

The motor drives the boat forward or backward, and can be regulated to run at any speed up to four miles an hour,



SUBMERGED MOTOR FOR ELECTRIC BOATS.

using two boxes of four cells, and will run from 20 to 30 miles on one charge. More cells may be used and a speed of six miles an hour attained, if desired.

The company's accumulators have an extremely large surface of active material and are capable of returning a large per cent. of the current with which they are charged. Each battery box containing two cells weighs about 50 pounds each, and is provided with a comfortable handle for carrying.

"It will easily be realized (without demonstration)," says the Submerged Electric Motor company, "that our motor being outside of the boat, and in the water, there is absolutely no strain or vibration, and on this account it is not necessary to build aboat of any extra strength or weight, in order to carry the power."

## QUESTIONS AND ANSWERS

"Subscriber": Would like to know if you can give me a pointer in preventing T. H. arc machines from flashing. All adjustments are made according to manufacturer's pamphlet, blower apparently runs well, ammeter steady, but still the machine will flash. Have tried everything I can think of, but of no avail.

Ans.—The most likely source of your difficulty is that the brushes are not correctly set. A very slight movement will make a tremendous difference in their operation. Again, the blower, though apparently working well, may not be delivering the blast onto exactly the right spot; twisting it slightly may get you over the trouble, or yet again the trouble may be in the lamps, which may be feeding irregularly enough to affect the operation of the machine, and yet not show on the ammeter. An overload will sometimes cause this type of machine to flash, as will a speed appreciably below normal.

---

"Superintendent": What are the main points in choosing between glass and porcelain insulators for a transmission line?

Ans.—The making of a definite choice between these two materials is a difficult matter, as each has certain advantages not possessed by the other; again, each is free from certain objections to which the other is subject. For transmissions through unoccupied territory not easily patrolled, glass is objectionable on account of its brittleness, as the insulators are found to suffer from being used as targets by passing gunners. A porcelain insulator when hit will chip off only at the point struck, the remainder still holding the line in place. A glass insulator on the other hand will shiver to pieces and drop the line unto the cross arm; again, as far as the actual insulation goes, porcelain is not as hygroscopic as glass, i. e., will not condense moisture as readily on its surface. On the other hand, glass is considerably cheaper, and flaws or cracks can be detected by the eye, whereas with porcelain they have to be tested for. The general concensus of opinion seems to be, that as far as experience goes to-day, glass is perfectly satisfactory up to potentials of about 4,000 volts, above that porcelain is more generally used, though glass is in successful use in isolated cases for potentials far exceeding these figures.

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W. E. Armstrong, London: Will you kindly answer through your "Questions and Answers Department" in the Electrical News the following questions: 1. To what class or type of arc dynamos does the machine known as the "Reliance" and used so much in Ontario, belong? 2. Will you give a diagram or explain the connections of the Reliance automatic switchboard? 3. Is there any rule for determining the potential difference between the carbons of an arc lamp—the current strength of the circuit being known as a matter of course?

Ans.—1. To the closed coil Gramme ring type, as distinguished from open coil armatures, or those with a drum type of winding. 2. We regret that we have no information available on this type of switchboard, though we are under the impression that its principal feature consisted of automatic jacks which were arranged so as to permit the charging of circuits from one machine to another without disturbing the operation of the lamps, but perhaps some of our readers can give you more definite information. 3. The voltage across an arc is governed by the same laws as all other drops of potential in electrical circuits, namely, E, (the arc voltage) = C (current) times R (impedance or resistance) of that part of the circuit under discussion. This latter figure is, of course, difficult to measure, varying with the size and separation of the carbons, the amount of current passing, and in alternating circuits, with the frequency. It is usual to so adjust open arc lamps, of capacities not exceeding 10 amperes, that the arc voltage shall be between 40 and 45. Higher amperages usually run with a lower arc voltage. With enclosed lamps on 110 volt circuits the figure varies between 70 and 75 volts; for 220 volt lines 140 to 150 is the usual value.

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"J. F.":—How many lamps can be run from a horse-power?

Ans.—A horse power consists of 746, or say 750 watts, and as we presume you purpose to use a 16 c. p. 50 watt lamp, the lamps per horse-power are obtained by dividing 750 by 50, which gives 15. It should be noted that this method of calculating does not make any allowance for losses in either outside or interior wiring, nor for those occurring in transformers, which will have to be reckoned with should the system be alternating, and the amount of 15 reduced by a percentage the same as the sum of all the losses, or in other words for a total of 8 per cent. loss in transformers, line and interior wiring, you would be able to light but 92 per cent. of 15 or 13.8 lamps per horse power. The same reasoning holds true for lamps of higher or lower efficiency than 50 watts per 16 candles, a 45 watt lamp giving 50/45 of 15 or 16.6, and a 60 watt 50/60 of 15, or 12½ lamps per horse power.

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"Student": What is the method used for determining the loss of potential in street railway circuits, taking into account both the overhead copper and the rails?

Ans.—The ordinary formula of $E = \frac{11CD}{\text{cir. mills.}}$, E being the volts lost, C the current in amperes, and D the distance (one way) in feet, holds good for the overhead or copper part of the line. The track is somewhat more difficult to estimate, the result obtaining varying with the size of the rail and the style and condition of the bonds, but the constant for the rails varies from .2 (being for exceptionally good track) to .8 (very poor track) of the above copper constant of 11, the result for average work being a combined constant of 14.5, which is the figure generally used when figuring on rails of about 70 lbs. per yard, the bonds being in good condition.

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"W. J. K.": Will you kindly advise me the power which I will require to drive an 8-foot boring mill, a 60-inch planer, and a 72-inch lathe?

Ans.—The above machines, under the usual conditions, will respectively require about 4, 10 and 4 horse power delivered to each, though obviously these figures will vary considerably with the cutting speeds, the material and the size of the cut, except in the case of the planer, where the maximum power consumption is governed principally by the relative speeds of the cutting return strokes, as when reversing to return the machine will call for one and one-half to three times its average power demand.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
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### *EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**The Canadian Electrical Association.** The Secretary of the Canadian Electrical Association has received through Mr. A. A. Dion, immediate past president, a cheque for $100, being a refund of two-thirds of the amount voted by the Association for entertainment purposes in connection with the annual convention held in Ottawa last June. Mr. Dion states that the Committee are pleased to find themselves in a position to make this refund to the funds of the Association. The thanks of the members are certainly due the Committee and the citizens of Ottawa for their generosity in providing almost entirely at their own expense the splendid programme of entertainment enjoyed by those who attended the convention.

**Niagara Power** In the light of the oft repeated statements in the daily press that arrangements are being made to transmit electricity for the generation of commercial light and power from Niagara overland to Toronto, it is interesting to note the opinion of Thos. A. Edison reported as having been expressed in a recent interview, that the thing can't be done. When asked "Why?" Mr. Edison's laconic reply was "no money in it." This is the crux of the whole matter. If it can be shown that there is money in the undertaking it will certainly be carried out, otherwise not. The opinion prevails that the recent rise in the stock of the Toronto Electric Light Co. has some connection with the project to transmit current from Niagara, but the evidence to substantiate the theory is not yet forthcoming. The Journal of Electricity, of San Francisco, approves of the views of a writer in the Saturday Post, of Philadelphia, who predicts that the immense body of water constantly passing over Niagara, will eventually be employed to drive electrical machinery, leaving nothing to the tourist but a bare wall of rock, and that in like manner the minor water falls throughout America will disappear.

**The Toronto Industrial Exhibition.** Notwithstanding the counter attraction offered by the Pan-American Exhibition, the number of exhibits at the Toronto Industrial Exhibition was as numerous as in former years. In live stock the exhibits were considerably greater, and the stable accommodation proved inadequate. The number and quality of the electrical exhibits which are more fully described elsewhere, was in advance of any previous year. The conclusion seems justified that the success achieved this year under adverse circumstances, might be greatly amplified if the Main Building and several of the other important ones, were replaced by modern structures designed to fulfil in a more perfect manner the requirements of exhibitors. That there is need for reform in the management is shown by the fact that after the opening of the Exhibition this year the root of the Main Building leaked like a sieve. In consequence many of the exhibits were seriously damaged. The management should have known that the roof was defective, and the necessary repairs should have been made before the Exhibition opened. It would be unwise, however, to spend any considerable sum for repairs as the building is no longer capable of fulfilling the requirements. The support that has been given the Exhibition in spite of its many defects, is a guarantee that if properly managed it will develop into an enterprise of vastly greater importance in the future.

There were to be seen this year a number of exhibits from the United States in addition to those of Canada, a proof that the value of the Exhibition as a means of advertising is becoming more widely recognized. The presence of these foreign exhibits side by side with those of our own country, affords opportunity to make comparison between the quality of home and foreign productions. As a rule the result is a higher appreciation of the home article.

**A Suggestion**

It may not be out of place to suggest to electrical companies the wisdom of cultivating the good will of the citizens of the municipalities in which they do business. Some companies have followed the unwise plan of doing about as they pleased regardless of the wishes of the citizens. Such a course is certain to react injuriously, not only upon the individual company, but upon all companies similarly situated.

**The Telephone Abroad.**

A municipal underground telephone system has just been put in operation in Glasgow. The system covers 16,500 miles, provides for 20,000 subscribers, and is designed to give cheap and convenient communication. As the result of public dissatisfaction with the service and charges of the National Telephone Company, a movement is said to have been started with the object of installing in the leading cities of Great Britain under municipal control systems similar to the one which has just been inaugurated in Glasgow. A re-organization of the Australian system is also proposed, the switchboards and other appliances at present in use being out of date, and consequently inefficient. A conference of leading electrical engineers of Australia has been appointed to suggest what steps should be taken to reorganize and standardize the system.

**The Nernst Lamp.**

In a paper read before the American Institute of Electrical Engineers, Mr. A. J. Wurts gave a most complete history of the development of the Nernst lamp in the United States. The facts presented by Mr. Wurts have been received by the electrical fraternity with a great deal of satisfaction, and have, it would seem, created a more favorable impression of the lamp than had previously existed. The development of this type of lamp so far would seem to place it in the rank of a competitor to the arc rather than the incandescent lamp. Compared with the incandescent lamp, it is more complicated, requires to be cleaned at regular intervals, and is expected to be relatively much higher in cost. In the United States the smallest Nernst lamp yet manufactured is of 50 candle-power. The superiority over the incandescent lamp is said to be in color and efficiency only. A more favorable showing is made in comparison with the arc lamp. The Nernst lamp is reported to be steadier in action, about equal in price, and capable of being operated directly from 220-volt mains without the insertion of several lamps in series, and also of being adapted to trolley-car lighting. A further advantage claimed for it is that it may be operated on low frequency circuits. It is also well adapted to the purposes of general illumination and decorative interior lighting. If in commercial use the Nernst lamp is found to be all that is claimed for it, there is no doubt that it will meet with favor in some particular field, but is not likely to replace entirely even the arc lamp. Referring to the progress of the lamp in Germany, Mr. E. Kilburn Scott, in the Electrical World, says: Hitherto the cost of manufacture has kept the new lamp from being a commercial success, and now this is in a fair way of being solved. In the A.E.G. works the lamps are extensively used, and they are also employed by many private consumers, to whom a rental of 75 cents per annum per lamp fixed is charged, there being nothing extra to pay for the renewal of the filament. To buy outright the price is \$1.67 and 50 cents for each extra filament. The lamp is made for any voltage up to 250, and the fluctuatiou of pressure which has such a detrimental effect is taken care of by a special device in the latest type of lamp. The pleasing effect of the lamps was abundantly manifested to all the members present, and the ladies seemed to be especially impressed by the fact that by gently blowing on the filament the light could be put out. Of the economy of the lamp over an ordinary incandescent lamp the A.E.G. have now accumulated overwhelming evidence, as well as the very interesting fact that the efficiency of the lamp is maintained practically constant throughout its life."

**Storage Batteries.**

Storage batteries are quite a feature of the Pan-American Exposition. Edison's storage battery, which is on exhibition, has naturally been examined with much curiosity. The one exhibited is of 1/8 horse power, 100 ampere-hours, and weighs 5¾ pounds. The cell is of steel, nickel plated. The negative plate is of nickel and the positive of iron. The fluid is not an element of the battery, it being used simply as a conductor. In the ordinary construction of the batteries, 60 plates will constitute one horse power, each plate weighing one pound. It is understood that Mr. Edison has withdrawn his battery from competition with other batteries, probably for the reason that he is not yet prepared to make public what are as yet secrets of the laboratory in connection with the battery. The Gould Storage Battery Company are exhibiting what is said to be the largest storage battery cell yet constructed. It has fifty positive and fifty-one negative plates, 15½ x 31 inches. The rating of the cell is 2,000 amperes for 8 hours discharge, and it is shown in actual operation. A switchboard with sufficiently heavy conductors and a small motor driven dynamo of 2.6 volts E.M.F. are provided for charging.

## MONTREAL LIGHTING CONTRACT.

The lighting of the streets of Montreal has recently engaged the attention of the city council. The present contract with the Royal Electric Company expires on the 31st of December, 1903, and is at the rate of \$120 per arc light of 2,000 candle power. Tenders were invited in June last for the future contract. The figures submitted were as follows: Royal Electric Company, \$95 per light per annum; Lachine Rapids Hydraulic & Land Company, \$90 per light; Standard Light & Power Company, \$99 per light, all for a five or ten year contract, Imperial Electric Light Company, \$85 per light for a five year contract, or \$80 for a ten year contract; Shawinigan Water & Power Company, \$79.93½ for a five year contract, or \$78.47½ for a ten year contract; St. Lawrence Power Company, \$54.75 per light for a five year contract. At a meeting of the council in July, a motion to award the contract to the lowest tenderer was voted down, and it was decided to postpone consideration of the question until September. On the 3rd inst. the council, by vote of 18 to 15, decided to give the contract to the Royal Electric Company at \$60 per lamp per annum for a term of five years.

## EXHIBITS AT THE TORONTO INDUSTRIAL EXHIBITION.

Reference is made below to the exhibits of our advertisers at the recent Toronto Industrial Exhibition:

The oldest firm in the belting line in Canada is the J. C. McLaren Belting Co., who have been established for 45 years, with offices in Toronto, Montreal and Vancouver. This firm had an extensive exhibit of genuine English oak belting in the Machinery Hall, Mr. J. E. Stephenson, Ontario representative, being in charge.

F. E. Dixon & Company, Toronto, exhibited oak tanned leather belting. This firm are also agents for S. E. Norris & Company, of London, England, and showed samples of Warren's pulley cover, which is applied with a brush, and which it is claimed will stop all slipping of belts.

D. K. McLaren, of Montreal and Toronto, showed a good display of genuine oak belting, as well as the Lancashire hair belt. Mr. E. Richardson, Toronto, was in charge of the exhibit.

The Dodge Manufacturing Company, Toronto, had a fine exhibit of wood-split pulleys, Dodge system of rope-driving, friction clutch pulleys and couplings. They also showed an automatic car shovel and automatic safety car puller used for pulling cars, with a capacity of from five to eight cars, a mule stand used for belt-driving around corners and angles, and a jack shaft and quill fitted with Dodge split friction clutch.

The Waterous Company, of Brantford, Ont., exhibited two high-speed McEwen engines, one 50 h. p. and the other 150 h.p. This engine is especially adapted for driving electric light dynamos.

The Canada Brass & Electrical Company, Limited, of Toronto, showed dynamos, generators and lamps, also an improved motor.

The Hardill Compound Engine Company, of Mitchell, Ont., had on view a 50 horse-power Hardill engine. This engine is a model of economy, strength, and simplicity. It is claimed to be constructed along different lines than any other compound engine, and is fully protected by letters of patent. Instead of two valves, each operating attached to two separate cylinders, this has two steam chests, both of which are connected with the two cylinders, and situated midway between the high and low pressure, the valves being operated by two separate eccentric rods.

The Northey Company, Limited, Toronto, had a large exhibit, and showed a line of steam pumps for boiler feeding and water works and other purposes, also gas and gasoline engines in full operation.

The Gould, Shapley & Muir Company, Limited, of Brantford, had a large and varied display of gas and gasoline engines, a feature of this exhibit being the unique arrangement according to the size of the engines.

The Jones & Moore Electric Company, of Toronto, had a fine display of electrical machinery, illuminated with a variety of colored lights.

The Goldie & McCulloch Company, Limited, Galt, Ont., showed a 100 h.p. Wheelock engine in operation running the north line of shafting, 80 h. p. Ideal engine also operating the south line of shafting and several of the electrical exhibits; fast feed flooring machine; 4-sided 12 inch moulder; 26 inch smoothing planer; Nos. 1 and 2 shapers; 12" and 16" Buzz planer; 2 spindle boring machines; lot of wood rim split pulleys; new self feed rip saw table; 6" sash sticker; 10 h.p. gasoline engine; 4 h.p. gas engine; 3 h.p. gasoline engine; Emery chopping mill, etc.

The United Electric Company, of 134 King west, Toronto, made an attractive exhibit of machines and apparatus of their own manufacture. The dynamos exhibited ware arranged and operated as under the usual working conditions; in fect, the whole exhibit was a practical working plant. There were shown the largest direct current Multipolar generator ever exhibited at the Industrial Exhibition. This machine, of a capacity of 200 horse-power, operated long burning arc lamps, incandescent lamps, and motors, all of 250 volts. Connected to the circuit were lamps intended for street and commercial lighting, of plain and ornamental finish, and guaranteed to burn 200 hours with one carboning. Other machines shown were inductors, alternators, and induction motors, transformers, multipolar and bipolar dynamos and motors, switch-boards, and several arc dynamos.

## MOONLIGHT SCHEDULE FOR OCTOBER.

| Day of Month. | Light. | Extinguish. | No. of. Hours |
|---|---|---|---|
| | H.M. | H.M. | H.M. |
| 1.... | " 6.15 | P.M. 9.40 | 3.25 |
| 2 ... | " 6.15 | " 10.30 | 4.15 |
| 3.... | " 6.15 | " 11 30 | 5.15 |
| 4.... | " 6.15 | " 0.30 | 6.15 |
| 5.... | " 6.15 | " 1.45 | 7.30 |
| 6.... | " 6.00 | " 2.45 | 8.45 |
| 7.... | " 6.00 | " 3.45 | 9.45 |
| 8.... | " 6.00 | " 4.45 | 10.45 |
| 9.... | " 6.00 | " 5.30 | 11.30 |
| 10.... | " 6.00 | " 5.30 | 11.30 |
| 11.... | " 6.00 | " 5.30 | 11.30 |
| 12.... | " 6.00 | " 5.30 | 11.30 |
| 13.... | " 5.45 | " 5.30 | 11.45 |
| 14.... | " 5.45 | " 5.30 | 11.45 |
| 15.... | " 5.45 | " 5.30 | 11.45 |
| 16.... | " 5.45 | " 5.30 | 11.45 |
| 17 ... | " 7.00 | " 5.30 | 10.30 |
| 18.... | " 8.00 | " 5.30 | 9.30 |
| 19.... | " 9.00 | " 5.30 | 8.30 |
| 20.... | " 10.00 | " 5.45 | 7.45 |
| 21.... | " 11.00 | " 5.45 | 6.45 |
| 23.... | A.M. 0.10 | " 5.45 | 5.35 |
| 24.... | " 1.10 | " 5.45 | 4.35 |
| 25.... | " 2.30 | " 5.45 | 3.15 |
| 26.... | No Light. | No Light. | .... |
| 27.... | " | " | .... |
| 28.... | " | " | .... |
| 29.... | P.M. 5.30 | A.M. 8.30 | 3.00 |
| 30.... | " 5.30 | " 9.30 | 4.00 |
| 31.... | " 5.30 | " 10.30 | 5.00 |
| | | Total........ | ....217 20 |

## CANADIAN WATER POWERS.

There is another big power scheme which will soon be brought before the Provincial Government at Toronto, Ontario. It aims to develop the water power northwest of the town of Port Arthur, Ont. The capitalists behind the scheme figure out that on the completion of the Canadian Northern Railway, Port Arthur will become a great flour milling centre. They have in consequence set to work buying land for a canal 22 miles long to connect with and divert the Kiministiquia River. There is said to be an easy route between the high levels to a point 3½ miles north of Port Arthur, where the syndicate proposes constructing a reservoir with an area of 1500 acres. When the route has been secured, it is not expected that much influence will be required to ensure the water power of the river in West Algoma being quietly conceded by the Ontario Government to a company.

## DYNAMO ILLS AND REMEDIES.*

A dynamo or motor, carefully installed and properly running, is truly a thing of beauty to those who have the care of it, and a source of satisfaction to its owner. Trouble, however, in one form or another is sure to come sooner or later, depending on the grade of the machine and the skill and care in handling.

It is therefore likely that a few hints as to the cause and remedy of such troubles will be acceptable to those who have the care of this class of machinery.

Obviously, the promptness with which such troubles are located and removed will have much to do with the success of the plant. Often, indeed, considerable expense is incurred in removing a fault, which with a little intelligence could have been remedied at trifling cost.

For instance, so slight a thing as a loose connection will often cause the shutting down of a whole factory with scores of hands. Other troubles equally as simple but not so easily located will cause annoyance and delay. In such cases, some knowledge on the part of the man in charge in locating troubles would have enabled him to overcome the difficulty and save delays and consequent loss.

Fortunate it is that the machines in question are mechanically so simple in their construction. With the exception of cummutator and brushes there are but two wearing parts, the two bearings which support the shaft of the armature, quite in contrast in its simplicity to the steam engine with the multiplicity of wearing parts, oil cups and valves.

From the fact that the dynamo or motor has so few parts, we are able to classify their troubles through their effects under five heads, which are:

1. Sparking at cummutator.
2. Heating of the various parts.
3. Noise and speed.
4. Motor stops or fails to start.
5. Dynamo fails to generate.

Any and all of these effects are quite obvious, even to the casual observer; still a most careful and thorough examination should be made of the entire machine in order to be sure of facts and avoid jumping at conclusions.

In the consideration of troubles as classified above the following order will be observed: First, the cause; second, the sympton in detail; third, the remedy and how effected.

As is very often the case, a symptom may be developed in a machine from several causes. We shall, however, endeavor to make the distinction as clear as is possible without the help of the actual machine for illustration.

Sparking at the commutator is caused, first, by the armature carrying too much current, due usually to an overload; in the case of the dynamo, too many lamps in circuit; or in the case with the motor, excessive frictional load, from hot bearings, armature striking the pole pieces, belt too tight, or in general, too much mechanical work to be done. Excessive voltage on constant potential circuits will also overload the system.

The symptoms are continuous sparking at the commutator during the time of maximum load and tendency to slipping of the belt.

*From the National Engineer.

After a continuous run, the armature becomes very much overheated and will burn out if the load is not lightened.

In this, however, there is an exception, constant current arc motors. As the heating effect depends on the square of the current multiplied by the resistance ($C^2 R$), both of which factors are constant in this instance, it is quite possible to overload machines of this type till the armature stops without risk of burning it out.

Excessive friction load is readily detected by turning the armature around by hand.

Hot bearings will be treated more in detail under the head of heating of the various parts.

An excess of current is, of course, at once evident at the ammeter, and this may be taken as a conclusive test for all such overloads.

The remedy, for troubles of this nature, is obviously to reduce the load and eliminate partial short circuits in the line and leads as far as possible.

Constant potential motors, especially those above five horse-power, are frequently subjected to overloads and strain at starting.

If the starting-box has too little resistance or is turned on too rapidly, it will cause the armature to start with a jerk and spark badly at first. A properly designed starting box will remedy the evil in the first instance, and in the latter case, the exercise of proper care in starting. The handle of the starter should be allowed to remain an instant on the first and second contact points till the armature has attained some speed.

Again, brushes are sometimes not set at neutral points. The symptom of this trouble will be a sparking and cutting at the commutator, the intensity of which will vary with the shifting of the brushes.

The remedy can best be explained by referring to Fig. 1, which shows the proper position of the brushes. The points where the brushes are resting on the commutator where the greatest E.M.F. and the least sparking are obtained, are called the neutral points, as represented in the cut by the points "A" and "B."

The line joining these two points has been termed the diameter of cummutation. It will be noted that this line is not at right angles to the line joining the centers of the pole pieces, but is shifted through a small angle, depending on the direction of rotation and

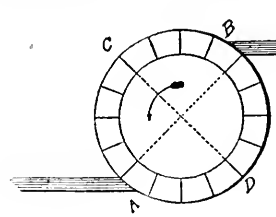


FIG. 1.
The Diameter of Cummutation.

whether the machine is acting as a dynamo or motor.

With the dynamo, the brushes will be given a forward lead, that is, they will be shifted from the horizontal in the direction of rotation.

With the motor, the shifting of the brushes will be against the direction of rotation and will be given what is termed a backward lead.

In most dynamos and motors the exact position of the neutral points cannot be fixed, but will vary accord-

ing to the load of the machine. For instance, in case of a dynamo with a given number of lights burning, the brushes may be properly set at the neutral points and run without sparking. Now let the number of lights burning be increased or diminished to any considerable extent and sparking, more or less destructive, will commence and continue till the brushes have been shifted to the new neutral points by means of the rocker arm. These points are determined only by trial.

This shifting of brushes, or giving them a lead as it is called, is necessitated by armature reaction or the magnetizing effect of the current in the armature, tending to create a powerful magnetism which distorts the field.

Right here we will state that there are some dynamos and many motors in which it is not necessary to shift the brushes, no matter how much the load changes. In these the field has been made strong enough to overpower the armature reaction. Again in another class of dynamo, the moving of the points of contact is taken advantage of as a method of increasing or decreasing the E.M.F. This is the case of constant current arc machines.

It is not only necessary to shift the brushes to the neutral points by means of the rocker arm, but care should be taken to see that the brushes are diagonally opposite each other. This can be accomplished by counting the number of segments of the cummutator, measuring with a piece of thread or other device, marking the opposite segments, and setting the brushes to this mark.

The setting of brushes is perhaps the most important

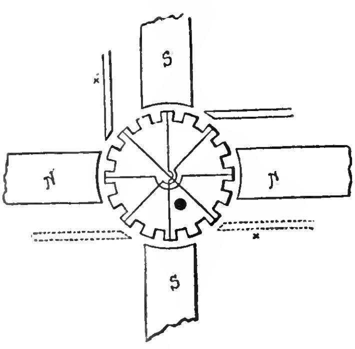


FIG. 2.
Circuits of Cross Connected Armature. Four Poles; Two Brushes.

duty of the dynamo tender, for a brush, a fraction of a segment out of position, will often cause serions sparking.

Exceptions to the rule for setting brushes diametrically opposite will appear in the case of multipolar motors with cross connected armatures.

These machines may be supplied with two sets of brushes or as many sets as there are poles. For instance, four pole machines with two sets of brushes require them to be set at 90 degrees apart; 6 pole at 60 degress, or 180 degrees, and so on.

Fig. 2 shows the armature connection and the position of the brushes in a four pole machine with cross connected armature. The arrows mark the direction of the current in the armature connection. It is apparent, therefore, that no one should attempt to set the brushes on such a machine without first determining from a blue print or other source their correct position, and then keeping them there.

Should the brushes be set very far out, they will probably cause the safety fuse to blow and in the case of a dynamo it will fail to generate.

The commutator may have high bars or low bars due to loose shell or an unusually hard specimen of copper.

A poor connection between the leads and the tongue of the commutator segment, will also develop a flat,

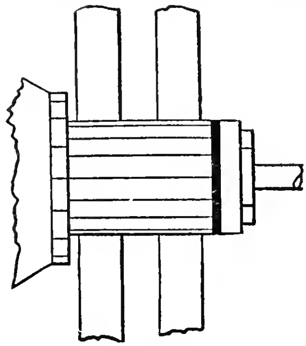

FIG. 3.
Commutator in Good Condition.

hard mica between the segments which does not wear down as fast as the copper; all of these produce a rough commutator.

The sympton in this case will be a chattering of the brushes, accompanied by sparkling, which is sometimes apparent by the sound. By touching the commutator with the top of the finger the least roughness is at once apparent. Turn the armature slowly by hand when any eccentricity will be indicated by a rise and fall of the brushes.

The commutator as it should be is represented in Fig. 3, with brushes properly set and the surface of the commutator smooth and glossy.

Accompanying is a sketch of the same commutator in bad condition. The commutator being scarred and rigid and the brushes badly set.

In cases where the commutator exhibits eccentricity or is deeply cut, the armature should be taken out,

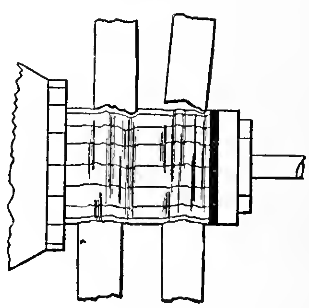

FIG. 4
Commutator in Bad Condition.

accurately centered in a lathe and the commutator turned off, taking off as light a chip as possible.

In large armatures it is often more convenient to rig up a special slide rest and turn off the commutator while the armature is turned at slow speed in its own bearings.

A loose bearing will also cause chattering of the

brushes with the attendant sparking and cutting of the commutator. If the bearings are loose and worn they should be re-babbited or new ones put in. A slide rest which clamps on to the pillow block in place of the rocker arm is shown in Fig. 6.

A slightly rough commutator can be dressed down with a fine file and given a final application of fine sand paper, the armature being turned at medium speed.

If the machine in question is a dynamo it is advisable to raise the brushes, start the engine at medium speed and apply the file or sand paper, or both, as the case may be, thus avoiding clogging the brushes with dirt and copper dust.

With a motor it is different, as we must rely on the current to turn the armature. It is therefore an exceedingly dangerous practice to use a file, although sand paper may be applied without danger. It is a good plan to put a little oil on the sand paper, for in this way the particles of copper are gathered and prevented from flying into the armature, thus increasing the danger of short circuits or burnouts.

It may be stated as an axiom that copper-dust and metal filings in general should not be allowed to collect about a dynamo or motor. For this reason emery cloth should never be used on the commutator, as the particles of emery are so sharp they become lodged in the copper of the segments, thus converting the commutator into a veritable grinding tool. Again the particles get into the mica and cause short circuits.

Brush-holder screws sometimes become loose and the brushes get tipped up so that they touch only at one point. Very often vaseline or oil has been applied too freely and the commutator has become dirty. The springs which give tension to the brushes may have lost their temper from carrying the current, though this is an indication of a faulty design of brush holder. The bearing part may have been clogged for some reason so that the holder does not work freely—though the spring may still be good. Hard carbons that will not

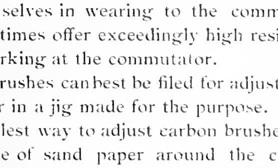

Fig. 5.—A Low Bar.

adjust themselves in wearing to the commutator, and which sometimes offer exceedingly high resistance, also induces sparking at the commutator.

Copper brushes can best be filed for adjustment to the commutator in a jig made for the purpose.

The simplest way to adjust carbon brushes is to first wrap a piece of sand paper around the commutator, having the rough side of the paper turned out; then set the carbon brushes down tightly against this surface, revolving the amature by hand while the brushes will be rapidly and accurately shaped to the surface.

The best way to keep a commutator clean is to wipe it at intervals with a piece of cotton cloth or felt slightly moistened in vaseline.

A motor with short circuited coils or bad grounds will draw excessive current, even though running free of load. A dynamo will require considerable power though there is no evidence of power in external circuit; in either case violent sparking will result.

The sympton most apparent will be a heating of the coil or coils affected, and the attendant will become warned of the danger by the odor of the burnt cotton insulation.

A short circuited armature coil often results from allowing copper dust to collect back of the commutator or when excessive sparking of the brushes has formed little bridges of metal across adjacent commutator segments.

Short circuits in parts of the coils of an armature frequently occur from injuries to the insulation, from external mechanical sources, for instance, the dropping of little particles of material in the spaces between the armature and the pole places while the armature is in

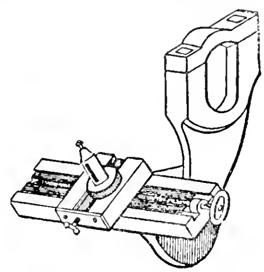

Fig. 6.
A Tool Clamping on Pillow-Block Used to Turn off Commutators.

motion. A screw, for instance, or even little balls of waste, and more frequently oil and dirt, cake on the faces of the pole pieces, scraping the insulation off the wires.

A piece of iron, a screw-driver or key, for instance, held between the field magnet, near the revolving armature, will vibrate very preceptibly as a short circuit coil passes.

In the case of a motor, an armature affected with a short circuited coil will revolve slower than usual and unsteadily, while in aggravated cases it will draw up with a jerk before the pole piece.

Ills such as those described as short circuits due to deposits of copper dust back of the commutator or the bridging over the segments from sparking may be located by careful inspection and removed by scraping clean the mica insulation between the segments.

Short circuits, due to mechanical injury to the insulation of the wire of the armature, require careful handling, as these injuries generally extend before the first layer of wire.

In most cases it is possible to carefully lift the wires, one at a time, high enough to wrap it with silk tape.

Wires thus raised and insulated must be carefully pounded back into place with a wood block or mallet, the affected part being then treated with a coating of shellac.

A short circuit which is in the coil itself and below the surface cannot be treated thus and the only real remedy is to rewind the coil.

Two or more grounds in an armature, occurring usually from insufficient insulation on the core, are equivalent to a short circuit and must be treated in the same way, viz., by re-insulating and re-winding the armature.

The commutator will flash violently when the broken coil passes under the brush, and it will be found that

the mica, surrounding the segments attached to the broken coil, will be blackened and burnt and gradually pecked away.

This break will often be found in the leads where the armature wires connect with the commutator, as in some types of machines they are subject to heavy drag. Usually they can be easily repaired by splicing.

An overload may cause the soldered connection of the leads to the commutator to melt and thus develop a break. The only avialable remedy is to solder in the leads again and guard against overload in the future.

Care must be exercised in the the soldering process lest drops of molten solder drop in behind the commutator and short circuit some of the segments.

When the trouble cannot be so easily located and is evidently in the interior of the coil, the coil thus affected will have to be rewound.

The trouble, however, may be temporarily remedied by cutting out the coil, either by bridging over the disconnected segment with a drop of solder or by staggering the brushes, as it is called, that is, setting one of a pair a little ahead and the other a little back of the normal position, which is equivalent to bridging over the break.

In adopting teis method, care must be taken not to short circuit a sound coil, as this will cause sparking and a dangerous heating of the affected coil.

These devices are at best only "make shifts" and sholud only be adopted to prevent a very undesirable stoppage.

Field troubles cause sparking at the brushes and are of two kinds, open circuits and short circuits.

A dynamo thus afflicted does not generate at all or does not come up to its full electromotive force. The pole pieces are not strongly magnetic.

A constant potential motor has a tendency to race unless the field is very weak or is lacking altogether, in which case it may be either run slow or stop and blow the fuse.

The cause for such trouble is usually a broken circuit or a partial short circuit in one or both of the fields.

In order to test for an open circuit in the field of a motor, block the brushes up from the commutator with pieces of wood or paper, then turn on the current, remove the field wire from its binding post and absence of spark at the breaking of the circuit will indicate a complete break somewhere in the circuit.

In cases of field trouble in isolated dynamos where current is not obtainable, it will be necessary to remove terminals of the field circuit from their binding post and ring through it with a magneto or bell and battery.

Short circuits in field coils may be determined by measuring, with the proper instruments, usually a portable bridge and galvanometer, the resistance in each magnet coil. Any appreciable difference in the resistance of the magnets will indicate that the one of least resistance has been short circuted.

A machine thus affected will spark more at one brush than at the other when running, and it will further be noticed that the short circuited magnet will heat less than the sound one, which in turn will be above the normal.

The remedy for such troubles is to remove the faulty magnet and unwind the wire on it till the break or ground is found, when the fault may be repaired and the wire wound back again.

It may be stated here that a frequent cause of short circuits in field magnets and armature is due to the soaking they receive from oil thrown out by faulty bearings.

Oil, soaking into a field, seems to have the effect of rotting the insulation on the wire and a short circuit or ground is the result.

A carbon brush of high resistance may cause sparking because of its poor contact with the commutator. A charring or burning of the brush about the edges will be noticed and the brush itself becomes hot, in which case supply a softer brush.

Again, vibration in the machine due to insufficient foundation is frequently a cause of sparking. It will be found to decrease when the machine is braced. Often nothing more is needed than a slight increase in the tension of the brushes. The better way, however, is to secure the machine firmly to a good substantial foundation of masonry.

A chattering of the brushes is sometimes due to a dirty and sticky condition of the commutator. This is apt to be the case with radial carbon brushes. To remedy this wipe the commutator clean and then lubricate it with oil or vaseline rubbed on with a piece of cotton cloth or felt.

A trouble to which the same armatures are liable, and which is sometimes very difficult to locate, is what is termed a flying break.

This will develop after the armature is in motion, causing violent sparking with every indication of an open circuit, but will not be apparent to tests made when the armature is stationary. It can usually be found by careful inspection of the back and can be repaired with thoroughly good soldered joints.

## SPARKS.

Mr. Ormond Higman, C.E., chief of the Electrical Inspection Department of the Dominion Government, has established an inspection office at Charlottetown, P.E.I., in charge of Mr. J. H. Bell.

The arbitration proceedings to fix the valuation of the plant of the Kingston Light, Heat & Power Company, at Kingston, Ont., are likely to be completed very shortly. It has been brought out that the plant has cost the company $131,220.80. The company pays a yearly rental of $12,252.37, and in 1900 the receipts were $58,820.98, with an expenditure of $51,063.48, leaving a balance of $7,757.50.

A new company has been formed in Montreal, known as the Dominion General Engineering Company, Limited, to manufacture the Tree rotary engine, the invention of Mr. E. B. Tree and Dr. Taylor, of Princeton. This engine was for a short time manufactured at Woodstock, Ont. The company will have a capital of $500,000, and includes Messrs. J. W. Greenshields, K. C., and W. H. Lawrie.

The Snoqualmie Falls Power Company, of Seattle and Tacoma, has placed an order with the Pittsburg Reduction Company of 250,000 lbs. of aluminum wire cable, which will more than double the capacity of their transmission system. Co-incident with this the enlargement of the generating station at the head works is under way, and an additional pen stock will be installed, having 50 per cent. more capacity than the first one. This penstock will feed three waterwheel sets, each one of which will drive a direct connected 5,000 hp. generator. The underground cavity will be extended eastward about 150 ft. to accommodate the increase. The Snoqualmie plant when this increase is made will have a capacity of 25,000 horse power, and will therefore, it would seem, be the largest water power plant in the United States outside of Niagara. All the electric street cars, all the municipal and domestic lighting, flour mills, machine shop and industries where eletric motors are employed in Seattle and Tacoma, are run by the Snoqualmie plant.

# ELECTRIC RAILWAY DEPARTMENT.

## THE LATE JOHN ROSS KERR.

The late John Ross Kerr, whose death took place in Montreal early in August, was born at Kingston, N.Y., on November 20th, 1872. He was employed for about three years at the C.P.R. shops, Montreal, and for a time in the works of the Dominion Bridge Company. Removing to Toronto, he was engaged for nearly three years with the Toronto Street Railway Company, in the shops and as inspector of motors. In 1893 he entered the works of the Canadian General Electric Company at Peterboro, Ont., remaining there for two years, when he was chosen from among

THE LATE JOHN ROSS KERR.

the many students there to manage the Galt, Preston & Hespeler Street Railway, which position he held for four years.

Mr. Kerr's health becoming impaired, he decided to go to Jamaica, and accepted the position of manager of the West India Elecric Company, of Kingston. His management of this road was eminently successful. In June last he returned to Canada on a business and pleasure trip, but was taken ill while in Montreal and died on August 4th. He was buried in the family lot at Kingston, N.Y., on August 6th.

## BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

The fifth ordinary general meeting was held at Cannon Street Hotel last month. Mr. J. Horne-Payne, K.C., presiding (in the absence of Mr. R. M. Horne-Payne, the chairman, in British Columbia). In moving the adoption of the report, he said that the board congratulated the shareholders on the great prosperity of the company. He compared the condition of affairs to-day with their position 2½ years ago, showing the great advance that had been made. The gross earnings for the past year were £102,435, or £27,235 more than in 1898, an increase of 36.19 per cent. The net earnings showed results not less favorable. In 1898, when they invited shareholders to bring in new capital, they were £27,870; for the year that had just expired the net earnings were £41,092, or an increase of £13,212, or 47.4 per cent. That progress had involved an inevitable increase of capital. In a business such as theirs, with a prosperous and constantly growing lighting and traffic, they had to be continually finding new capital. The capital expenditure was shown in detail in the report, and included £52,415 for lighting extensions. The larger that item was the better they were pleased. Every success in lighting meant an increase in net revenue. There was an outlay of about 17s. per lamp upon which they were continually earning a return. There was also the item of the new power house for supplying energy to meet the new demands, and the new machinery, boilers, and rolling stock, the last mentioned to cope with the growing traffic. The board had to be very careful with reference to the growing demands for fresh capital expenditure however unavoidable, and they might find it advisable in future to recommend ordinary shareholders to reserve their large cash earnings to meet that expenditure.

The report was adopted, and resolutions declaring dividends, re-electing directors and auditors, and thanking the directors, were also passed.

## A ROYAL TROLLEY CAR.

A magnificent royal car—probably the first in the world built for royalty—is now under construction by the Ottawa Electric Railway Company. The company is not sparing expense to make it one of the best electric cars that has ever run on any track. It is to be finished in a most elaborate manner, and on the front will be painted the name of the car, "The Duchess of Cornwall," and on the other side will be carved the royal coat of arms. The car is to be finished in the royal colors, and on the inside, besides the fancy brass work and plate mirrors, will be a number of wicker and upholstered chairs. The car will carry the royal party to Britannia, where the Ottawa lumbermen will have a timber crib, which will be boarded for a trip through the Deschenes rapids and down the timber slides at Chaudiere Falls. The design of the car has been approved by Lord Minto and Sir Wilfred Laurier.

## AMERICAN STREET RAILWAY ASSOCIATION

THE twentieth annual meeting of the American Street Railway Association is to be held at Madison Square Garden, New York city, October 9th to 11th. A large number of very interesting papers will be read and discussed, and the attendance promises to be the largest in the history of the association.

The Canadian Pacific Railway has, for some time past, been considering the practicability of utilizing the great stores of energy contained in the vast water power of the Rocky Mountains by converting this power into electrical energy and utilizing it to haul trains up the steepest grades. At the present time a number of assistant engines have to be kept at these points to help the trains over. It is probable that before long some definite plans in this connection will be laid before the directors.

The Van Buren Lumber Company has been organized at Bangor, Maine, to operate saw mills at Van Buren, Maine, and at Edmunston and St. Anne, N.B. It is the intention of the company to install electric plants at Van Buren and Edmundston for the lighting of their mills and the streets of the villages. Mr. John M. Stevens, of Edmundston, and E. A. Hammond, of Van Buren, are directors of the company.

## NEW APPARATUS FOR THE OTTAWA ELECTRIC COMPANY.

The Ottawa Electric Company has recently contracted with the Westinghouse Electric & Manufacturing Company for a new equipment, including three 700-kw generators, to be equipped for waterwheel connection, and two 700-kw belted generators. In addition there will be supplied three 250 h. p. induction motors, one 300-kw rotary, with two 105-kw transformers, one motor-generator outfit of 22½ kilowatts capacity, one 37½-kw slow-speed multipolar generator and a special 56½-kw multipolar type generator.

Each of the 700-kw turbine-driven generators is a two-phase machine, and is to be of the two-bearing type, with a coupling on the shaft for direct connection to the end of a waterwheel shaft, revolving at a speed of 180 r. p. m. At 60 cycles each machine will have an output of 159 amperes per terminal at 2200 volts under a non-inductive load. The external frame will be divided in a vertical plane and movable from the shaft to permit easy access to windings. In all, there will be 40 poles upon this frame. The winding of the field coils is to be of strap on edge. The armature of the slotted drum type will be built up of laminated steel of the highest magnetic quality. Its wire-wound coils will be continuous and retained in position by fiber wedges. The two-phase current will be collected by special brass rings of the open ventilated type employed by the Westinghouse Company. The temperature conditions and regulation will be excellent.

The requirements of the Ottawa Electric Company were that the generator should under a non-inductive load have an efficiency of not less than 83 per cent. at one-quarter load; 90.5 per cent. at one-half load; 93 per cent. at three-quarters load, and 94½ per cent. at full load.

The machine will operate for 24 hours at 2200 volts, and at 159 amperes per terminal, at from 90 per cent. to 100 per cent. power factor with a rise in temperature not to exceed 40 degs. C.; at 25 per cent greater current with the same power factor for 24 hours the rise in temperature will not exceed 50 degree C.; at 50 per cent. greater current the rise in temperature will not exceed 60 dgs. C.

The 700-kw belted generators are of the three-bearing type with rotating armature. Each will generate two-phase currents at 2200 volts, 159 amperes per terminal under a non-inductive lood. The journals will be self-oiling and self-aligning, while the shaft will carry a pulley 58 inches in diameter and 72 inches in face. The frame of the horizontally divided type will contain 22 poles, and at a speed of 327 r. p. m. the frequency of the machine will be 60 cycles. The regulation will be very close. In the case of this machine the Ottawa Electric Company requires that, on a non-inductive load, the efficiency should be less than 84 per cent. at one-quarter load; 90½ per cent. at half load; 93 per cent. at three-quarters load, and at full load 94 per cent.

The field coils will be wound with strap on edge and are to be placed on pole pieces so designed as to reduce the armature reaction and the self-induction to a minimum. The armature coils are to be continuous, wound from strap copper and retained in place by wedges of hard fiber.

The 250-h.p. induction motors are to be two-phase, Type "C," Westinghouse constant-speed C motors, with self-oiling and self-aligning bearings. They are intended to operate directly on the 2200-volt circuit at a speed of 580 r. p. m. under full load. Each is a 12-pole motor weighing approximately 11,000 lbs. The parts are a cylindrical yoke carrying the primary windings, and to which will be bolted circular end brackets to carry the bearings, and a rotating squirrel-cage secondary. The motor will have an efficiency of not less than 90 per cent. under its full load of 250 horse-power, and a power factor of not less than 91.5 per cent. The temperature conditions are a normal load for 24 hours, with a rise not to exceed 40 degs. C.; a 25 per cent. overload for 24 hours with a rise not to exceed 50 degs. C., and a 50 per cent. overload for one hour with a temperature rise not to exceed 60 degs. C. It is intended to place a 125-light Brush arc machine on each end of each motor and to make direct connections by suitably flanged couplings.

The 56½-k. w. generator is of the special multipolar type, compound wound for 125 volts, and is intended to operate at 475 r. p. m. Its shaft is to be extended that the coupling may be placed outside of its pulley, and each machine is to be equipped with belt-tightener, base plate, flange coupling and pulley. Each of the 37½-k. w. direct-current generators is to be of the slow-speed multipolar type, compound-wound at 125 volts. The motor-generator outfit is to consist of one 22½-k. w. direct-current generator compound-wound for 250 volts, and one 30-h. p. slow-speed direct-current motor shunt-wound for 500 volts.

## CANADIAN CABLES.

The Department of Public Works at Ottawa has been advised that the Government steamer "Tyrian," now at Gaspe, Que., has completed repairs to the cable between St. Paul's Island and Meat Cove, Cape Breton, which has been interrupted for some time past. The "Tyrian" has now left Gaspe for the purpose of laying the cable across the Strait of Belle Isle, which is to connect the Belle Isle station with the Government telegraph station on the mainland of Labrador. By the end of August, the coast signal service will be in permanent operation to Belle Isle, which is a most important point on the summer route between European ports and the St. Lawrence. Steamships will, hereafter, be reported by telegraph 760 miles below the port of Quebec. This will mean that a 20-knot vessel, taking the summer course, can communicate her arrival on this side of the Atlantic in less than four days out from Liverpool, England.

## RED INDIAN TELEPHONISTS.

What is probably the only telephone system operated entirely by Indians is being installed in the village of Kish-Pie-Axe in Northern British Columbia. The system is to be connected by a 20-mile telephone wire from the telegraph office at Hazelton, half way between Ashcroft and Atlin.

That the tendency towards amalgamation now-a-days has been extended to journalistic circles as well as commercial,is shown by the recent purchase of The Canadian Home Journal by Mr. Hugh C. McLean, publisher of The Ladies' Magazine, Toronto. The Journal, which was established many years ago, will be discontinued as a distinct publication, and will be merged into The Ladies' Magazine, which has already won a place for itself as the popular home paper for Canadian women.

# ENGINEERING and MECHANICS

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

### TWELFTH ANNUAL CONVENTION.

THE Canadian Association of Stationary Engineers opened its twelfth annual convention in the City Hall, Brantford, on Tuesday, August 22nd, and it was one of the most successful in the history of the Association.

The following executive officers and delegates were in attendance: G. C. Mooring, Toronto, president; Charles Moseley, Toronto, vice-president; A. M. Wickens, Toronto, secretary; William Oelschlager, Berlin, treasurer; George Dawson, Hamilton, conductor; John M. Dixon, Toronto, door-keeper. R. Pettigrew, G. W. Dawson, Joseph Ironside, T. Chubb, Hamilton; W. J. Webb, J. Huggett, A. E. Edkins, E. J. Philip, W. Outhwaite, N. V. Kuhlman, J. M. Dixon, Toronto; J. R. Uttley, Waterloo; J. Heyd, Berlin; R. Turkington, Brockville; J. Struthers, Sarnia; James Ogle, Brantford.

The visitors during the convention included William Bourne, Thomas Pilgrim, A. McKinnon, Morgan Harris, Charles Waterous, David Waterous, Lloyd Harris, Joseph Butler, Charles Walker, Fred Temperance, L. Fordham, R. Lee, W. F. Gunson, Charles Doherty, Geo. Scace, J. Barker, E. Jones, J. M. Jones, D. Potter, S. Mills, W. H. Mitchell, J. Miller, W. Muir, W. H. Sweet, W. Brazin, D. Telfer, A. Sage, J. E. Taylor, J. Henderson, W. Schultz and J. Searle.

The opening business of the convention was the appointment of the following committees:

Committee on Credentials.—W. J. Webb, J. Ironsides, W. Oelschlager, J. R. Uttley, R. W. Turkington.

Committee on Constitution and By-Laws.—A. M. Wickens, J. M. Dixon, T. Chubb, J. Ogle, W. Struthers.

Committee on Good of the Order.—James Huggett, C. Moseley, Jacob Heyd, J. M. Dixon, A. E. Edkins.

Auditing Committee.—N. V. Kuhlman, W. Dawson, Peter Trowern.

Mayor H. N. Wood welcomed the Association to Brantford on behalf of the council and citizens, and hoped their visit would be a pleasant one. Aldermen Wade and Halloran also gave a few words of welcome.

Adjournment was then made until 2.30 p. m., when business was resumed. The president read his opening address, as follows:

### PRESIDENT'S ADDRESS.

Brethern,—I am proud of the honor of welcoming the officers, delegates and friends to this, the twelfth annual convention of the Executive Council of the Canadian Association of Stationary Engineers. We certainly made no mistake last year when we accepted Bro. Ames' invitation to hold our next convention in Brantford. I wish to thank you for placing me at the head of this organization a year ago—the highest office in your gift, an honor which I have always craved. I hope you will overlook my short-comings, for they are many. It gives me the greatest pleasure to greet old friends and welcome new ones, to help along the work of this, the best engineering society in the world. Our old friends must have performed this work well at other conventions or they would not have been sent back again as representatives. I hope to see the younger members as well as the older ones take an active part in all our deliberations. I ask that you support the occupant of the chair as on all former occasions.

For my part I will endeavor to give equity and justice to all. I understand tnere are many matters of grave importance to to come before this meeting for your most earnest consideration, such as: Shall we meet annually or bi-annually? What can be done to increase our membership? Shall we keep on trying to secure an inspection and license law from the Ontario government? In this last matter we have certainly advanced one step since last we met, in securing the inspection of boilers by the factory inspectors. I would say, keep on pegging away until we get such a law or turn the party out. Our progress has not been as rapid as I would have liked, still we are advancing slowly but surely. We have started one new Association in Sarnia since our last convention. We have been trying to wake up some of the dormant ones. We have increased our membership and our finances are in a healthy condition, as will be shown by the treasurer's report. The secretary, past-president Wickens, who has had most of the hard work to do, will enlighten us on the work of the year. I hope his report will be full and comprehensive. I have no doubt the subordinate associations have been careful in the selection of their new members. But, brethern, we must admit that there are many good engineers outside of our order. I do hope that the Ways and Means Committee will devise some plan to interest these men, and show them that it is to their advantage as well as ours, to throw in their lot with us, that we are working for them as well as ourselves, our employers and the public at large.

Quite a number of our associations have done good work along the educational line by having open meetings, lectures, short talks, etc. I am sure the thanks of this order is due to those members on the different educational committees. Their work is of permanent benefit to this society. In closing, I wish to thank the officers and members for their kind and liberal support

EXECUTIVE OFFICERS AND DELEGATES C. A. S. E. CONVENTION, BRANTFORD, AUGUST, 1901.

| | | | |
|---|---|---|---|
| 1. J. R. Uttley. | 7. J. Ironsides. | 13. S. McKinnon. | 19. A. E. Edkins. |
| 2. Joseph Ogle. | 8. R. W. Turkington. | 14. W. Bourne. | 20. T. Chubb. |
| 3. J. Pierce, | 9. A. W. Smith. | 15. James Dixon. | 21. W. Outhwaite. |
| 4. W. J. Webb. | 10. J. F. Birchard. | 16. Charles Moseley. | 22. J. Struthers, |
| 5. George Dawson. | 11. E. J. Philip. | 17. G. C. Mooring. | 23. P. Trowern. |
| 6. R. C. Pettigrew. | 12. N. B. Kuhlman. | 18. A. M. Wickens. | 24. S. Pilgrim. |
| | | | 25. James Huggett. |

during the year. Let us always remember our motto, "Safety, Economy, Regularity, Intelligence.

G. C. MOORING,
President Executive Council.

The address was received with applause and referred to the Committee on Good of the Order.

The Secretary then read his annual report, which was as follows:

SECRETARY'S REPORT.

"Our membership report last year gave us 162 members to start the year with, divided up into 9 associations. We have been able to start one new branch Sarnia, No. 20 and can report it as a vigorous and earnest association. We are pleased to say that our membership has increased, and is now 288 members, comprised in 10 associations. We have also many encouraging letters from ex-members in towns where the work has lapsed, and hope to be able to report several of them again in active work. We fully expect that London, Kingston and Ottawa will again be in line. The recommendation of the Committee on the Good of the Order, to have the different associations visit neighboring towns for missionary work and to promote organization, has not been acted upon by any of the lodges, and any work of that kind has fallen upon the secretary. We would strongly recommend that a small committee be struck for that purpose and that a small sum of money be placed at their disposal. Your legislative committee again put forth their best endeavors for a license law. We had joint meetings with the O. A. S. E., and interviews with several crown ministers, and entered a bill which passed two readings, and by advice from the Hon. H. H. Carscallen, who presented the bill, it was withdrawn, as the government had promised a bill for boiler inspection. The government then amended the Factories' Act so that boilers coming under the Act must be inspected, and such law is now in force. As to the working of it, however, we can say nothing. The trouble seems to be that there are no inspectors. The manufacturers request that any engineer of five years' experience be allowed to inspect is wrong, as no man should inspect the plant he operates. Your committee appointted to see the Locomotive Engineers re legislation, visited them at their meeting and explained to them our position. After some discussion we left, feeling that we had removed their opposition. The matter of issuing papers for this year has not been carried out fully. We had some delay and also considerable difficulty in getting together a proper mailing list. The delay carried us into the legislative season, during which all our time was fully occupied. I am still strongly recommending that these papers be resumed, but would ask for a small committee to help, as it is rather too much work and responsibility for the secretary alone to assume. Our hand-book business is still unsettled. I have since last convention received settlement for 80 books, and also have acknowledgment for 16, which will soon be converted into cash. I have in hand 5 books. There are still some 90 books that no settlement can be had for, because it is impossible to find the persons they are charged to. The receipts and expenditures have been as follows:

| RECEIPTS. | | EXPENDITURE. | |
|---|---|---|---|
| Capitation dues | $141 00 | Paid Treasurer | $348 15 |
| Treasurer | 266 22 | Convention expenses | 44 35 |
| Stationery | 27 43 | Printing | 51 50 |
| Charter | 15 00 | Postage | 13 15 |
| | | Charter | 12 50 |
| | $469 65 | | $469 65 |

A. M. WICKENS, Secretary.

The treasurer's report was submitted by W. Oelschlager and referred to the auditing committee.

The Secretary was instructed to forward letters of condolence to Past-Presidents W. F. Chapman, of Brockville, and Thos. Ryan, of Montreal, both of whom have recently lost their wives, and a letter of sympathy to President T. Graham, of Toronto No. 18, who is indisposed.

The meeting then adjourned to visit the works of the Waterous Engine Company and accept their kind invitation for a drive around the city. The visit to the works proved most interesting and instructive. The first places visited were the draughting-room, pattern shop and blacksmith's shop. The latter building is 60 x 120 feet, and contains 16 large forges and a pneumatic rivetter with a capacity of 75 tons pressure on rivet. The next part visited was the boiler room. The dimensions of this room are 220 x 80 feet. Here we found two large boilers 6 feet in diameter, 16 feet long, and 125 pounds pressure. Next a visit was made to the moulding shop, 180 x 80 feet. Here a large number of men are constantly employed moulding patterns. They also have a pattern vault of three stories, each 80 x 60 feet. The next place visited was the fire-engine department, where was seen in process of construction a large engine for Magog, Que., which has since been exhibited at the Toronto Industrial Exhibition.

The drive was resumed around the city to the pumping house, where D. Webster is in charge. The visitors then repaired to the Cricket and Lawn Tennis Club House, where an appetizing lunch was served by Messrs. C. H. and David Waterous.

EVENING SESSION.

The evening session, which was an open one, was well attended. A paper on "Wasted Heat" was read by Mr. Wickens, and one on "The Relation of Employer and Employee," by J. M. Dixon.

An invitation from Mr. Lloyd Harris, vice-president of Brantford Board of Trade, for a drive on the following day to visit the Bow Park Farm, was accepted.

SECOND DAY.

At 9 o'clock a.m. the President called the convention to order.

The reports of the Committees on Mileage, Auditing, and Finance were presented and adopted.

On motion by Messrs. Edkins and Lawlor it was decided to take up the report of Committee on Constitution and By-laws clause by clause.

Section 1 of Article III was amended so as to reduce the term of practical experience necessary for membership from 3 years to 2 years. The candidate must be a resident of Canada for at least one year, and of the jurisdiction of the lodge for at least 3 months.

Section 4 of the same article was amended to read as follows: "All subordinate associations shall pay with each semi-annual report in advance a per capita tax of 25 cents for each member on their books in good standing."

Section 13 of Article IV was amended to relieve the trustees of the duty of auditing accounts.

A fourth section was added to Article VI, as follows: "If a candidate does not present himself for initiation within four months after being balloted for, he shall forfeit his fee and have to make a new application, unless by a two-thirds vote the lodge decides otherwise."

A new Section was added to Art. VIII, which now reads as follows: "Section 1. The application fee shall be $1, and shall be paid by all candidates." "Section 2. The initiation fee shall not be less than $2, and shall be paid by all candidates."

The report of the Committee on the Good of the Order, as finally adopted, is as follows:

1. That at the next session of the Legislature this Association shall petition that body to pass a law regarding Engineers and Boiler Explosions and Accidents, similar to the law now in force and working so satisfactorily in Great Britain.

2. That a committee be appointed to issue 8 Educational Papers to the local Associations (and steam users if it be deemed advisable) in each year—as we regard such issues as a link between the Executive and the local Associations.

3. That Executive Officers should visit each local Association at least twice a year, and in our opinion this duty should be performed by the Executive President, or failing this, by some other member under his instructions.

4. That the Executive Officers should meet twice a year and be prepared to advise the local branches as to their government, etc.

5. That we would impress upon the Convention assembled the necessity of the delegates impressing upon the membership of their respective Associations the importance of the educational feature in their meetings, as being the means of stimulating the growth and general advancement of the Association as a body.

6. That in our opinion the financial books and accounts of this Association should be audited before this Convention assembles, in order that the work may be properly done and expedite the business of Convention.

7. That the Executive Secretary be imperatively instructed to call in all charters that are lapsed, forthwith.

8. The matter of ways and means has been referred to us, but in our opinion the scope of this matter is too wide for us to deal with, when time is so limited, therefore we beg respectfully to leave said matter with the Convention as a body.

Adjournment was announced, and a visit paid to the Bow Park Fram, Brantford Pork-Packing Company's factory, and the plant of the Brantford Electric & Operating Company. The President and John M. Dixon thanked Mr. Harris for his kindness, to which he replied in a very neat speech.

AFTERNOON SESSION.

The President in the chair, called the Convention to order at 2.30 p.m. R. C. Pertigrew recommended the purchase of the chart of the metric system, and it was decided that one be purchased for each Association. Discussion on the subject of "Printed By-Laws" came up. On motion of R. C. Pettigrew, seconded by N. V. Kuhlman, permission was granted to have the by-laws printed by each local Association, if desired. R. C. Pettigrew spoke of the lack of publicity the Association was receiving from the press. Messrs. Edkins and Phillips made the statement that is was entirely the fault of the Secretary of the different branches in not advising the press of the proceedings of their respective branches. The representatives of the Canadian Engineer and CANADIAN ELECTRICAL NEWS assured the Convention that notices of meetings and other information would always be willingly published.

The election of officers was then proceeded with, and resulted as follows:—President, Charles Moseley, Toronto; vice-president, W. Oelschlager, Berlin; treasurer, G. W. Dawson, Hamilton; secretary, A. M. Wickens, Toronto; conductor, John M. Dixon, Toronto; doorkeeper, J. Struthers, Sarnia.

Educational Committee—A. M. Wickens, J. M. Dixon, W. J. Webb, J. Huggett, E. J. Phillip.

Legislation Committee—E. J. Phillip, A. E. Edkins, W. Outhwaite, N. V. Kuhlman, A. M. Wickens, J. Huggett, George Mooring.

The retiring president, G. C. Mooring, was presented with a past master's jewel. The next order of business was the selection of a place for the next annual convention. After a spirited voting contest Toronto was chosen. The usual grant was made to the Secretary, and votes of thanks were tendered to the Mayor and aldermen, the scrutineers, the press, and to those who had assisted to entertain the delegates.

THE BANQUET.

The annual banquet was held at the American Hotel on the evening of the 23rd ultimo, Mr. Charles Moseley, Toronto No. 1, officiating as chairman. After the sumptuous repast was disposed of the toast list received attention. Responses were made as follows: "The King." "Ontario the Banner Province," T. H. Preston, M.P.P.; "Brantford, the Telephone City," Mayor D. B. Wood; "The Manufacturers," C. H. Waterous; "The Executive Council," A. M. Wickens, E. J. Phillip, John M. Dixon; "The Press;" J. F. Birchard, CANADIAN ELECTRICAL NEWS, and A. W. Smith, Canadian Engineer. The evening was one of wit, humor and jollity, and the respondents to the different toasts, who handled their subjects very capably, were heartily applauded at the conclusion of their remarks. During the evening a musicl programme was rendered, in which J. M. Dixon, of Toronto, and Sam. Burnley, of Brantford, assisted materially. The local committee, Messrs. Pilgrim, Ogle and McKinnon, were heartily thanked for their untiring efforts to entertain the delegates.

HAMILTON NO. 2.

At the last regular meeting of Hamilton No. 2, a vote of thanks was tendered to the members of the Brantford Association for the manner in which the delegates were entertained at the recent convention in that city. A motion was adopted that the open educational meetings for the coming season be commenced on October 10th. A committee was appointed, and some very interesting papers are likely to be given. The Association is endeavoring to help not only members of the Association but all persons interested in engineering work.

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The scheme to transmit electric power from Keewatin, Ont., to Winnipeg Man., has again been revived. The Keewatin Power Company about four years ago completed at large expense the construction of an immense dam across the Winnipeg river just at the point where it issues from the Lake of the Woods. It is constructed of granite stone and English Portland cement. The power thus developed is 30,000 horse power, which has not been utiltzed. The improvements in long distance transmission have been such that the company are said to have decided to install the necessary plant at once for the utilization of the power, and are now negotiating with electrical manufacturing companies with a view to placing the contract. The intention is to transmit the power to the city of Winnipeg.

## WASTED HEAT.*

By A. M. WICKENS

THIS subject is so far reaching that we cannot fully go over it in a paper as short as this must necessarily be, so we will content ourselves by looking at some of the points connected with it. As heat is the source of life, and also of all motion, its influence penetrates everything in the whole universe. The great heat given to the countless worlds that travel in their orbits, in a boundless and immeasurable space, is from the sun. Sir William Herschel tells us that if a cube of ice 45 miles in diameter and 200,000 miles long were placed endwise into the sun, it would be melted in one second of time. What the effect of this vast heat is on other worlds we cannot tell; what the conditions of life, what manner of souls, what kind of an atmosphere, nor in fact any of the particulars, we know not. Had we a full knowledge of all things we undoubtedly would be able to utilize the great sun heat, to create our motive power direct from its rays, and while our knowledge of other worlds is extremely limited, we have been able to learn something concerning our own surroundings, and the wonderful combinations of nature, provided by an all-wise Providence for the use and benefit of the inhabitants of this earth. If we could imagine anything perfectly cold, it would be without motion, perfectly still, and absolutely dead. The earth, the rocks, the trees, the air, are all moved continuously, and are subject to constant vibration, the direct cause of which is the heat and light of the sun. The human eye and ear, two of the most wonderful parts of our organism, would be useless to us as they are now constructed, were it not for the vibrations of the light and heat of the sun coming to us through the atmosphere surrounding the globe. It is by utilizing these vibrations that we have telephones, telegraphs, electric lights, music and many of our conveniences and pleasures of life. As we become more enlightened on this line, it will be safe to say that much of the complication of construction, cost of operating and maintainance in all these different branches will be reduced, and we as engineers should also expect as we gain knowledge to be able to show better results in the evaporation of water for power purposes.

The efforts of the eminent engineers of the world during the last fifty years have been in a great measure directed toward the improvement of the steam engine; their strides have been rapid, their achievements great and their success almost phenomenal, resulting in a reduction of water consumed per horse power hour, from over 60 lbs. to 12½ lbs. The improvements in the evaporative efficiency of our boilers have not kept pace with the engine improvements, and it seems to me that we must look for greater evaporative efficiency in our boilers to further reduce the cost of steam as a prime mover. The man who daily utilizes the heat should, if he will study it up, be able to convert into mechanical work a greater portion of the heat of the fuel than is now generally utilized. It is evident in order to do this he must first acquaint himself with the component parts of the fuel, and the chemical combinations that occur during its combustion.

The advancement of all science during the last century has been marked by greater discoveries than all the preceding centuries before it; galvanism, magnetism, electricity and chemistry have been developed until they are factors for our daily use. The greatest discovery in chemistry was oxygen, made by D. Priestley, in 1774. Its discovery was really an accident, but was soon turned to account by the learned doctor. In the study of chemistry several things should be kept in mind: 1st. Where is the element under study to be found? 2nd. How can it be obtained in a separate state? 3rd. What are its properties? 4th. What other elements will it combine with, and what will be the resulting compounds?

Oxygen is the most widely connected with the other elements of all our gases. It composes about 1-5 of

*Paper read at annual convention Canadian Association Stationary Engineers, Brantford, August 22, 1901.

the atmosphere, and fully 8-9 of all our waters. Its most remarkable propensity is its energy in supporting combustion, anything that will burn in atmospheric air will burn in pure oxygen with the splendor of a meteor. Nitrogen, another of our gaseous elements, is part of our atmosphere, and composes about 4-5 of the atmosphere. It combines with the oxygen, but not chemically, (as we will see later on). It will not support either life or fire, and in its combination with oxygen it seems to dilute it in order that we may not live too fast, that our fires, lamps or any other material may not burn too fast, and also that our iron utensils may not rust too fast. The atmosphere being composed of oxygen and nitrogen, we have these two elements to combine with our coals in order to get heat. Taking the average quality of American coal we find it composed of carbon, oxygen, hydrogen, ash and sulphur ; we have then air composed of oxygen and nitrogen to mix with our coal. The air contains oxygen, 21 parts ; nitrogen, 79 parts ; and the coal has carbon, 80 parts ; oxygen, 5 parts ; hydrogen, 7 parts ; ash, 8 parts. Now what occurs when these elements are combined? The oxygen and carbon unite and form a new gas called carbon dioxide or carbonic acid gas. The oxygen and carbon combine, but the nitrogen in the air remains neutral and is still nitrogen ; this shows that its mixture with oxygen is only mechanical and not chemical. To support perfect combustion we must supply 1 lb. of carbon with 2.66 lbs. of oxygen, carrying with it 8.94 lbs. of nitrogen ; the product is 3.66 lbs. of carbonic acid gas ; the nitrogen, 8.94 lbs., passing off in an unaltered state, excepting that it has been heated by our fire, and is expanded into about double its volume. The total weight of the product of combustion is 12.6 lbs., but we have left out the hydrogen in the coal, also the sulphur ; we will require for the perfect combustion of 1 lb. of carbon, 1 lb. of hydrogen and 1 lb. of sulphur, the following quantities of atmospheric air : For the hydrogen, 34.8 lbs., or 457 cubic feet ; this product is water; for the carbon, 11.16 lbs., or 152 cubic feet, and the product is carbonic acid. The sulphur will use 4.35 lbs., or 57 cubic feet, product, sulphurous acid.

The heat units contained in one pound of carbon, perfectly burned, is 14,800 ; should the air be reduced to ½ in quantity, 5.7 lbs., or 76 cubic feet, the product would be carbonic oxide, sometimes called marsh grass. The heat units per lb. of carbon burned to marsh grass are only 4,800, thus wasting 10,000 heat units for each lb. of carbon thus burned. It is evident that the chief factor in the economical use of coal is to supply the correct quantity of air, and in order to do so, we must so construct our furnaces, grates and openings to carry the right amount of air. In tests conducted at the Centennial Fair in 1876, it was found that passing 24 more air through the fire than was theoretically required, had no effect upon the evaporative efficiency of the boiler. In a test of fifteen boilers there, it was found that by reducing the rate of combustion 30 , the quantity of water evaporated was only reduced 23 %, and at the same time the efficiency was increased 8½ %. This goes to prove there is no economy in forcing a boiler.

In Germany a test of nearly four years duration on two tubular boilers, steaming night and day, showed that 60 of the heat was utilized, and that more than half of the remaining 40 was lost through the brick walls. The average heat of the escaping gases was 360 degrees F. and carried off 5½ %, while losses due to ungenerated heat and unburned carbon was about one-half of 1 %. The proportion of grate surface to heating surface was changed three times. The most economical point being 10 foot grate to 340 feet heating surface. Sometimes the distance of grates from the boiler is a factor—do not get them too close. The proportions of tube heating surface to the shell surface should also be proportional about 5 to 1. The chief consideration for economical combustion is the correct air supply. It is not possible to attain perfect combustion with the theoetical amount of air, which is 11.16, or 152 cubic feet, per lb. of coal, because in the conditions obtained in our furnaces we cannot get the air into perfect contact with the burning carbon of the coal. For this reason we have to supply about double the quantity of air, or 24 lbs. If more air than is actually needed is allowed into the furnace it simply carries heat from the furnace to the chimney, while if too little is used we get marsh gas instead of carbon dioxide. If it were possible to heat the air during the short time it is going through the fuel up to the heat of the fuel, the theoretical amount would be all we would require for perfect combustion ; one of our losses in the furnace is the driving off by the heat of the hydro-carbons contained in all our bituminous coals, before these coals really begin to burn. These gases are driven off, and are very likely to escape unburned up the chimney. The admission of a small quantity of air above the fire will sometimes burn them. If they are not burned they escape as black smoke. The best smoke burner in the world is a fireman that knows how to handle his fires in well set boilers with ample draft.

## PERSONAL.

The sympathy of many friends is being extended to Mr. W. F. Chapman, engineer at the water-works, Brockville, Ont., owing to the recent death of his wife.

Mr. Edward Smith, manager at St. Stephen, N. B., of the local telephone company, has accepted a responsible position with an electrical company at Bellows Falls, Vermont.

Mr. George E. Waller, who has been chief clerk of the Hamilton, Grimsby & Beamsville electric railway, has been promoted to the managership of that road, as successor to Mr. A. J. Nelles, who tendered his resignation. Mr. Nelles had been manager for about six years.

The many friends of Mr. E. E. Cary will be pleased to learn that he has been appointed Export Manager for the Adams-Bagnall Electric Co., of Cleveland, Ohio, with offices in the New York Life Building, Montreal.

Mr. W. H. Lewis, who for several years has represented the Atlantic Refining Company, of Toronto, in Western Ontario, has been appointed manager of the Vancouver branch of that business. Before leaving Toronto an elegant music cabinet was presented to Mr. and Mrs. Lewis by their many friends.

The Quebec Railway Light & Power Company have appointed Mr. J. A. Everell superintendent of the Montmorency and St. Anne divisions of the railway, and Mr. H. N. Bartlett assistant superintendent of the Citadel division. Mr. W. R. Russell, general superintendent, has resigned.

Mr. William S. Aldrich, who has recently been engaged in consulting engineering practice in Toronto in association with Mr. Cecil B. Smith, has been appointed to the directorship of the Thomas S. Clarkson Memorial School of Technology at Potsdam, N. Y., and the partnership has consequently been dissolved. The entrance requirements of this school are those of the Regents of the University of New York. There are regular four year engineering courses in theoretical and practical work leading to degrees of Bachelor of Science in civil, electrical and mechanical engineering.

## TRADE NOTES.

An attractive catalogue of the Mumford steam boiler has been issued by the Robb Engineering Company, of Amherst, N.S. The design and construction of the boiler is fully illustrated and explained, and in addition there are several tables which will be found very useful to engineers. Persons interested may obtain a copy of the catalogue for the asking.

Every steam user and engineer should secure a copy of the catalogue just issued by the Jenckes Machine Company, of Sherbrooke, Que., descriptive of their horizontal tubular boilers. The work is replete with valuable tables of trimmings, fixtures, standard stacks, boiler setting, etc., and also contains plans for setting horizontal tubular boilers, and much other information regarding safety valves, injectors, etc. There is a carefully prepared index which permits of finding the information desired very readily.

CANADIAN
# ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. XI. OCTOBER, 1901 No 10.

## THE ASSUAN DAM IN EGYPT.

One of the most gigantic engineering works that has ever been undertaken is now in course of construction in Egypt. It is the building of an immense reservoir, the object of which is to provide perennial irrigation of Middle and Lower Egypt by raising the level of the Nile river, and thus to multiply the fertility of the land. The contract was let in the spring of 1898, and provided for the construction of two dams, one at Assiut and another at Assuan, within five years. The illustration of the Assuan dam, which we present herewith, is reproduced from Indian Engineering. This dam, the larger of the two, will cross the Nile river at a point where the First Cataract flows down into a narrow gorge, bounded on both sides by lofty rocks. The water above the dam will thus form a vast reservoir, whose waters will be stored in the flood season for use in the dry months. The total length of the dam will be over a mile and a quarter, and its height will be 345 feet above the level of the Nile at low water. It will be 80 feet wide at the base and 23 feet wide at the top. The wall is to be constructed of insubmergible masonry, built on a foundation of solid granite and pierced by 140 under sluices and 40 upper sluices. The provision of under sluices will prevent the deposit of silt in the reservoir. The amount of water to be stored is estimated at 1,065,000,000 cubic meters.

THE ASSUAN DAM, OVER THE NILE RIVER, IN EGYPT.

The dam will only slope outwards from the surface on its southern or reservoir side, which will have to resist an immense pressure of water. On its northern side it will be perpendicular. The upper sluices will be

lined with cast iron, and they, as well as many of the under sluices, will be worked by means of patent roller gates. The discharge at flood season will take place at the rate of 14,000 tons of water a second. The flood season, during which the water will be accumblating, lasts from about July to December ; it will remain stored to March or April, and will be used for irrigation purposes through the dry season, which extends from April to July. On the left bank of the river there is to be constructed a canal for navigation purposes, so that the dam will not interfere with traffic.

This great enterprise is being carried out by Englishmen. Sir Benjamin Baker, K.C.M.G., is chief engineer, and John Aird & Company, contractors. An English financier, in the person of Mr. Ernest Cassel, has advanced the necessary money, on the understanding that no liability would fall on the Egyptian Treasury until the profits from the undertaking should exceed the cost. The cost of the Assuan dam is estimated at £2,000,000, and it is calculated that the annual return to the Egyptian treasury will be £850,000, while the increased value of land in Egypt through the operation of the reservoir is estimated at £46,000,000. The total cost of the work, estimated at £4,800,000, will be met by annual instalments of £160,000, beginning on the completion of the dams and extending over thirty years.

## ELECTRICAL ILLUMINATIONS.

Never before in the history of Canada has there been such an extensive employment of the electric light for illuminative and decorative purposes as upon the occasion of the present visit of their Royal Highnesses, the Duke and Duchess of Cornwall. There is reason for congratulation that in the development of electrical science this country has so far advanced as to produce the magnificent display that was seen in Montreal, Ottawa, Quebec, Toronto, and even in the cities west of the lakes. The electric light lends itself to decoration in a most pleasing manner, producing artistic and harmonious color effects.

The lighting companies were called upon to supply a vast amount of additional current, and they showed themselves equal to the occasion. Naturally, the largest number of extra lights were called for in the city of Montreal, where it is estimated that 45,000 lights were connected up for the display. The Royal Electric Company had connected to its mains throughout the city approximately 25,000 additional lamps ; they were used upon the principal business buildings and residences throughout the city, as well as upon the different arches temporarily constructed for the Royal visit. These extra lamps, as well as those of their general customers, were supplied from the power-house at Chambly. Although bad weather was encountered while the construction work was in progress, it is gratifying to learn that every one of the 25,000 lights were kept going throughout the entire time, and that the installation was a complete success. The Lachine Rapids Hydraulic & Land Company and its associate companies, the Standard Light & Power Company and the Imperial Electric Light Company, connected up about 20,000 extra lights. It is said that the additional lights did not tax the power-house to any extent, and if the company had had sufficient transmission lines and transformers they could have supplied 60,000 more lights, as they have over 3,000 kilowatts installed. About thirty prominent business places and residences were supplied.

The number of additional lights supplied for illumination in Ottawa by the Ottawa Electric Company was, approximately, 25,000. These varied from 5 to 16 candle power, averaging about 10 c.p., which at 56 watts would represent 1,400 kilowatts. These were used an average of twelve hours, altogether making a consumption of 16,800 k.w. hours. About 18,000 of these lights were used by the Government for illuminating the public buildings, the "Royal Alexandra" and "Laurier" bridges and Wellington street, about 2,000 by the Street Railway Company in illuminating the streets over their tracks, and the balance in private illumination. The illuminations in Ottawa were quite artistic, and were carried out with an eye to beauty and artistic effect. The architecture of the Parliament Buildings being Gothic, lent itself admirably to the illuminations, which consisted in outlines of the buildings. The lamps were so arranged that in day time at 100 feet from the building nothing could be seen, thus the architectural beauty of the buildings was not marred by fixtures, as is often the case. The lights were brought up to brilliancy very slowly, as is done at the Pan-American Exposition. This was one of the most beautiful features of the display.

The historical city of Quebec, the first to be visited by the Royal party, was ablaze with electric light. The Jacques Cartier Water Power Company furnished about 8,000 incandescent lights for illumination purposes. These burned from dark to midnight during the nights of September 16th and 17th, and the energy consumed was between 4,000 and 5,000 k. w. hours, in addition to their regular load. The company were unable to obtain a sufficient number of transformers from the manufacturers, and therefore were obliged to use some 500 volt power transformers, which necessitated some of the installations having the lamps connected up in lots of five lamps in series, which worked very satisfactorily. In order that the illumination load would not affect the regulation of their regular lighting circuits, they connected them up onto the two sides of their two-phase power circuit in districts where this circuit was in reach. The Quebec Railway, Light and Power Company installed exactly 12,881 extra incandescent lights, aggregating 161,840 candle power and taking an extra current of 500 kilowatts. In addition there was a considerable temporary increase of 2,000 c. p. direct current arc lamps. The company had to refuse orders for about 5,000 extra lights on account of there not being sufficient time to install them. The extra lights did not in any way interfere with their regular customers, as they did not consume all the surplus currrent capable of being generated at the power station.

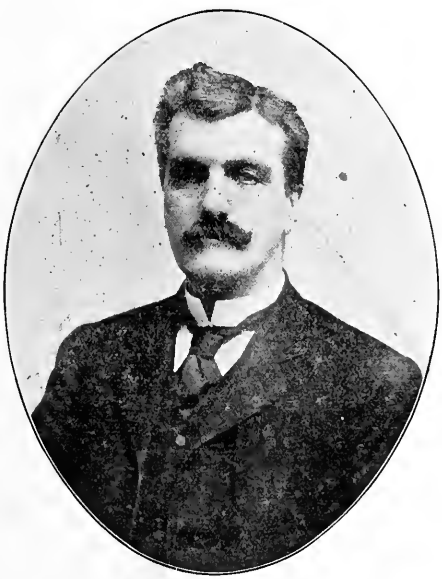
The Canadian Electric Light Company supplied 2,000 extra lights, of which 1,200 were 16 and 800 were 8 c. p. lamps. The largest installation by this company was for the Intercolonial Railway, and consisted of a luminous sign of eight foot letters, reading "Intercolonial Welcome." The most unique installation was the showing up of the outline complete of a schooner belonging to Messrs. G. T. Davie & Son. The stays, masts, gaff and hull were clearly indicated and presented a pretty picture. The signs were made of wood, painted white, mounted with cleat receptacle.

The electric lighting companies in the western cities did their part equally well. Just as we go to press the Royal party are about to visit Toronto, where the electric light will also form the main feature of the decorations. The Toronto Electric Light Company have wired up about 25,000 extra lights, while the illumination of the City Hall will be effected through the kindness of the T. Eaton Company, who have perhaps the largest private plant in the Dominion. The Temple Building and the Foresters' Arch will be illuminated by 14,000 incandescent bulbs, the power for which will largely be supplied by the private plant in the Temple Building.

## MAJOR WALTER H. LAURIE.

Any man who has sufficient knowledge and experience to run a donkey engine or even to keep a fire alight under a boiler will take to himself the title of engineer. There are very many who carry this designation worthily, but there are very few, even among those in prominent positions in engineering circles, who can be truly regarded as experts, possessing a thorough practical and theoretical knowledge of steam and the steam engine.

Among the latter class a notable example is Major Walter H. Laurie, general manager of the Laurie Engine Company, Montreal, a gentleman who has for many years been regarded as one of the leading authorities in the Dominion upon steam engineering. The Major is a native of the Eastern Townships, and went to Montreal at the age of twelve years, and after serving his apprenticeship in the machine shops of Mr. George Brush, he started business in the year 1871 in partnership with his brother, Mr. John Laurie, and commenced building engines in the year 1873. Ever since that time the business has steadily grown both in volume and reputation, so that now the name "Laurie" applied to an engine has become the equivalent to a guarantee of high class workmanship and the assurance of the machine incorporating all the latest devices for getting the greatest amount of work out of steam. As an instance of the engineering skill of the Major and those associated with him, it may be mentioned that in several instances he has offered to build an engine to replace an old plant free of charge, taking as payment the amount of money saved in the reduction of the fuel bill for a certain number of days after the installation of his improved plant. Such an offer is always received with incredulity and doubt, but we know as a matter of fact, that in several cases where it was accepted the result was extremely gratifying and satisfactory to both parties.



MAJOR WALTER H. LAURIE.

The first engine built by the Laurie Brothers was, as above stated, in the year 1873, and was a small 4 horse power engine, for the St. Mary's College, Montreal, and was for the use of the boys of the school in their carpenter shop. Almost as soon as this one was turned out a second was completed, a 14 x 30 slide valve engine. It was in the year 1880 that the first Laurie Corliss engine was built. This engine is still in existence and good for work for some years yet. The engine which first brought the firm into prominence was the large 4,500 h. p. engine built for the Montreal Street Railway in the year 1895. This engine, when it was built, was the largest on the Continent, and attracted a great deal of attention, not only throughout Canada, but descriptions and illustrations of it with favorable comments appeared in several of the United States scientific and engineering papers. The fly wheel of this engine weighs 100 tons; the low pressure cylinder is 64 inches in diameter, and the high pressure cylinder 36 inches. Since that date big engines have been the forte of the Lauries, and their plants are to be found in the street railway power houses of Montreal (seven engines), Toronto, Winnipeg and Vancouver, also in the electrical power house of the Dominion Iron & Steel Company at Sydney, and many other places.

Until recently they have confined their attention to large work, but within the last three months have turned their thoughts to a smaller class of engine, and from what we can learn there is a great future before their new "Rival" engine, an engine of from 5 to 50 horse power. Mr. Laurie in an interview says that he has given more thought and study to the designing of this engine in proportion to its size than to any other, and in return he says that no engine which he has ever turned out gives him so much satisfaction from an engineering point of view, and from what we know of the Major we are satisfied that when he says a thing he means it.

Many of us are considerably bothered at times by the man who has a new patent that is going to revolutionize the industrial world. Major Laurie gets more than his share of such visitors, he being such a well-known authority in mechanical matters, what with the people who come to him on their own account and those who are sent to him by others who may become interested, it is rare for two days to pass without some such visitor appearing at his office door.

The business of the Laurie Brothers was merged into an incorporated company, "The Laurie Engine Company," in 1894, and since that date extension and improvement has been the constant history of the concern.

It will probably interest some of our readers to know that Major Laurie was gazetted in 1878 (after some years previous service in the ranks) to a lieutenancy in the Montreal Garrison Artillery. At this time he was well-known as a marksman, and in the year 1879 he won the first provincial championship badge competed for in the Province of Quebec for military rifle shooting, and in same year captured all the first prize medals in the province, together with two Martini-Henry Rifles and considerable cash prizes, and in the following five years he won more provincial medals and badges than any other marksman.

In the year 1885 he was appointed on the Wimbledon team, but did not go with them to England, as a call for active service in the North-West came, and he went through the North West-campaign. Major Laurie retired from active service in 1897.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y
of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
BRANCH OFFICE: IMPERIAL BUILDING, MONTREAL.
Bell Telephone 2299.

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The ELECTRICAL NEWS will be mailed to subscribers in Canada, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to the C. H. Mortimer Publishing Company of Toronto, Limited. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

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*EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope o this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

## CANADIAN ELECTRICAL ASSOCIATION.



## ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.



## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.



**Electricity vs. Steam**

At the recent convention of railway agents in Toronto, Mr. E. W. Judd, editor of the Railway Age, drew attention to the serious competition of the electric railways for passenger business. The almost completed electric railway route between Buffalo and Toronto, was used as an illustration of the developments which are in progress in this direction. The success of the electric roads would mean the ruin of many ticket agents. The only means suggested whereby the steam roads could meet the competition of the electric lines, was by heavy reduction in rates and the running of more trains. This plan was said to have been successful in bringing back business to the Boston and Albany railroad which had been lost to the electric roads. It is doubtful, however, whether all steam roads having electric railways as competitors would be able to stand the expense of such a policy.

**The Royal Visit.**

Canada tendered a right Royal welcome to the Duke and Duchess of Cornwall and York, who have just left our shores after a month spent in visiting all parts of the Dominion. It is to the credit of our future King and Queen that they should have undertaken a nine months journey, traversing two-thirds of the earth's surface, with the object of acquainting themselves with the people and conditions existing in the various parts of the great British empire. The information which they have acquired will enable them to more capably discharge the functions of their high statio ı. The people with whom they have come in contact feel the that bond of sympathy and loyalty which binds them to the Empire has been further strengthened. Great commercial advantage is also likely to accrue to Canada from the descriptions of the country and its resources and opportunities written by representatives of the leading British and American papers who accompanied the Royal party.

**The Toronto Tehnical School.**

The Toronto Tehnical School has opened with the usual rush of students. The register shows that nearly 1,200 names have been enrolled since the opening of the session. This is the largest number in the history of the school and would seem to indicate that it is a much needed institution. The experience of the past shows, however, that a large proportion of those who enroll themselves as students at the opening of the school each year drop out of attendance at some time during the term. It would probably not be incorrect to say that the number of those who thus cease attendance at the various classes is not less than 50 per cent. of the total number enrolled. Owing to this condition of affairs the city is obliged to maintain a teaching staff for the instruction of the large number who enter the school at the beginning of each term, while a much smaller staff would suffice for the instruction of the students who attend the classes right through the term. The Board of Management will find it necessary to remedy in some way this condition. Probably the only remedy will be to require students to pay a certain sum on entering the school to be applied to maintenance account. This proposal has, we understand, been made at the meetings of the Board, but has met with strong opposition from the representatives of the Trades and Labor Council. We believe,

however, that some such step will have to be taken in the near future in order to avoid the waste of money which is now going on.

**The Canadian Exhibit at Buffalo.**

The impression given the visitor to the Canadian Building at the Pan-American Exhibition is that Canada is a purely agricultural country where buffalos, bears and all manner of wild animals abound. The building contains only specimens of grain, wild animals and furniture. While it is important that the advantages which we can offer to the farmer, the sportsman and the tourist should be adequately displayed, our capabilities in art and industry should also have prominence, otherwise strangers will receive a wrong conception as to our rank among the more highly civilized countries. It is true that the art gallery contains a small exhibit of pictures by Canadian artists, that in the Mining Building are to be seen some excellent samples of Canadian ores, and that in other departments such as live stock and farm and dairy products, Canada is well represented. But these exhibits are divided among various buildings and therefore do not impress the visitor as would a collective exhibit in one building. At least half the available space in the Canadian Building might profitably have been used for small, attractively arranged exhibits which would have served to give the visitor a bird's-eye-view of Canada's resources and development in a dozen or twenty different lines, and a measurably accurate idea of her advantages as a place of residence. People of refinement are loth to remove to a raw country, and it is to be feared that the character of many of the exhibits which we have made at foreign exhibitions has been such as to convey the idea that Canada is that kind of a country. Perhaps the best method of removing any such false impressions would be to inaugurate in Toronto on a suitable scale a Dominion Exhibition, and invite foreigners to come and see for themselves the beauty and capabilities of our country and the skill of our people.

**A New Vapor Lamp.**

One of the latest devopments in electric lighting is the Cooper-Hewitt Vapor Lamp, an invention which seems to follow pretty closely the lines of the Geissler tube. The lamp consists ot a glass tube say three-quarters of an inch in diameter and two or three feet in length, or of such other dimensions as the requirements may demand—the dimensions of the tube being determined by various considerations, such as the E. M. F. and the current with which it is to be operated. The air is exhausted from the tube which is then filled with mercury vapor, through which a current ol electricity is passed. The resistance offered by the vapor to the passage ot the current causes the tube to become incandescent. The inventor claims to have discovered that the electrical resistance of a gas or vapor bears a definite relation to its density and that it is possible so to control the density ot an enclosed gas or vapor acted upon by a current as to maintain that density at a predetermined degree, rendering its conductivity sufficiently stable and suitable for service as a light-giving medium, its efficiency in that respect being exceedingly great. Also that self regulation of the lamp may be attained by subjecting the gas or vapor path to such surrounding conditions as to secure the radiation ot heat at a predetermined rate, or means for supplying additional vapor to the conducting material as its density becomes too attenuated. While it isclaimed that the Cooper-Hewitt vapor lamp,unlike the Geissler tube, is adapted to operate under prevailing commercial conditions, no details have been published to prove that such is the case to show wherein are its advantages over the incandescent lamps now in use. Some of the enquiries which naturally present themselves to the mind of the practical man are : What intensity of light will this lamp produce ? and more important still, what is the cost ol its production ? Have operating tests been made under the usual commercial conditions ? It so, what results have been achieved ? It is all very well to be told that the new lamp "has been developed from a series of investigations highly scientific in their methods and conducted with great experimental skill." What central station owners and operators will want to know is, will the invention meet the requirements of every-day service more economically and satisfactorily than the arc and incandescent lamps now in use ? There is the possibility of a device being too "highly scientific" for this purpose.

**The Storage Battery for Traction Work.**

The experience of the Chicago Electric Traction Company brings out several facts which are of peculiar interest to those identified with electric traction. The decision of the company to discard the storage battery and employ the overhead trolley cannot be regarded as favorable to the former system, but is another step towards defining the conditions under which the storage battery can be employed economically. The road in question was built to demonstrate what could be done with the storage battery as a method of propulsion. It was decided to equip and operate a complete road rather than to experiment on roads already being operated by means of other systems. Skilled engineers were employed, and the power plant and road so constructed as to give the best possible results. The road composed about twelve miles of track, with three branches, making a total trackage of twenty-eight miles, consisting of ten miles of double track and eight miles of single track. The change to the trolley system was principally necessitated by the difficulty in operating the branch roads economically, as under the storage battery system it was necessary to run cars on the lines to the power house every trip for re-charging. The end of one branch being about eleven miles from the power house, it became necessary to install a supplementary charging station. A forty kilowatt generator, driven by a 50 horse power gas engine, was installed about two years ago, with the necessary equipment for handling the batteries. The additional operating cost necessitated by this sub-station averaged $400 per month. Considering that but eleven cars were being operated at the time, this was a large item of expense. It is said that everything in connection with the storage battery system worked successfully and smoothly from a mechanical point of view, but the operating expenses were very heavy. After being in operation for a comparatively short time, it was found that the batteries were worn out, and it was decided to put the required investment into an overhead system, which would be more permanent. The trolley road has been in operation for some weeks, during which time there has been a considerable saving in wages and depreciation. The

services of ten battery men were dispensed with, and but one additional attendant engaged for the power house. The experience of this company is an illustration of the necessity of carefully studying the physical conditions before employing the storage battery for railway work. Its usefulness in this field seems to be so limited that it is not destined to become a strong competitor to the overhead system. In a paper on "Notes on Modern Electric Railway Practice" read by Mr. A. H. Armstrong before the American Institute of Electrical Engineers, an opinion is advanced corresponding very closely to the practical experience of the Chicago Electric Street Railway Company. He says: "The storage battery is not adapted for an expanding system, and, furthermore, cannot successfully take care of long sustained over loads at the end of a suburban line fed from the city system."

## THE CHAMBLY TRANSMISSION PLANT.

The power transmission plant of the Chambly Manufacturing Company is the subject of a descriptive article in a recent issue of the Electrical Review, of New York. It is characterized by the writer as one of the most interesting power transmission plants in North America. Some particulars are given regarding the transmission line and the operation of the plant which have not heretofore been published. Unlike the majority of transmission lines, it is composed of a considerable number of succeeding aerial and underground sections, as may be seen from the following table, giving the lengths in feet of each division of the line from the power-house to the receiving station in Montreal:

| | | |
|---|---|---|
| Aerial | 5,400 | feet. |
| Submarine | 140 | " |
| Aerial | 68,153 | " |
| Subway | 9,200 | " |
| Aerial | 1,650 | " |
| Subway | 1,776 | " |
| Submarine | 285 | " |
| Subway | 1,015 | " |
| Total | 87,619 | " |

or 16.59 miles.

The sections marked submarine refer especially to crossings of the Richelieu canal and the Lachine canal in the city of Montreal. Along the length of the aerial line three strands of ordinary barbed galvanized iron fencing wire are strung, one being put at each end of the upper cross arm and one on top of the poles. This wire is mounted on pony glass insulators, although it is grounded at every pole by means of iron wires connected with iron earth-plates buried under the foot of the pole, the grounding wires being protected by an iron pipe passing down the side of the pole.

Near the terminal house at the Chambly end of the line is an arrangement whereby a load can be placed on one of the lines, for testing generators for example, by lowering metallic plates connected to the cables above end of the tail-race. An interesting result which has followed every test that has been made so far with this apparatus has been the killing of a number of fish in the tail-race as soon as the current is turned on.

The most interesting feature of the distributing station is the use of synchronous motors operated directly by the incoming line current, these machines being used for driving arc machines for street lighting at night, for working other machinery during the day, and running light with over-excited fields to compound out the induction factor of the line and bring up the power factor of the system to unity. By this method the power factor is kept normally as high as 96 per cent., the men at the switch-board having become very expert in regulating the field excitation of the balancing machines in order to bring about the desired results. Connecting with this distributing station are 125,000 16-c. p. incandescent lamps, 2,000 arc lamps, and a total capacity of 6,000 horse-power in motors. A large part of this power is furnished to the Montreal Street Railway Company, but a considerable quantity is used for operating induction motors for various purposes. A 550 h. p. induction motor is used for pumping water for a section of the city.

For motor service it has been found that contracts could be made with manufacturing establishments and others whereby the hours of work could be made to conform to the light-load hours on the station system, and that in summer both manufacturers and operatives were willing to work longer hours, while in winter shorter hours were practicable, the motor load of factories going off before the lighting load of the evening begun. The load curves, taken in different seasons of the year, show respectively average loads of 85 per cent. and 94 per cent. of the maximum load, and this extraordinary result has been obtained entirely by concessions to manufacturers and other power users who were willing to regulate their hours of work in accordance with the average demand of the city for power for all purposes. This result has been accomplished under the able management of Mr. Philip G. Gossler, the general superintendent of the Royal Electric Company. The new work of changing over the installation to 25,000 volts is progressing under the immediate supervision of Mr. Ralph D. Mershon, representing Mr. F. S. Pearson, consulting electrical engineer.

Editorially the Electrical Review makes the following comment upon the Chambly plant:

"The interest of this fine installation lies in the transmission line itself and in the method of compensating the low power-factor due to lagging currents and the method of protection against lightning.

"It is always interesting to see a deduction originally purely analytical made the basis of practical work of importance. The fact that over-excited synchronous apparatus would impart leading currents to the line with which it is connected or compensate out lagging currents has long been known, but its application has not often been practised, especiallly on such a scale as is exhibited in this transmission line. Notwithstanding the fact that the large total of six thousand horse-power in motors is operated upon the secondary distributing system in Montreal, the power-factor of the line has been held so nearly unity as practically to cause no trouble of any kind, and the full utility of the plant has been made available without excessive cost. It is also of interest to note that in four years of operation, generating directly a potential as high as twelve thousand volts in the dynamos, there has been no accident worthy of the name from electrical causes. This is practically a demonstration of the permanence of high-tension apparatus, and shows that its depreciation is nowhere nearly so high as was expected at the time the plant was laid down.

"Occasion was taken in these columns last week to refer to the barbed-wire lightning protection which has

proved so entirely successful upon this line. It seems somewhat astonishing to see a transmission line upon which so much depends absolutely devoid of the usual lightning-arrester apparatus. Experience, however, is the best teacher, and the protection which has been obtained from the simple barbed fence wire has proven entirely adequate and, indeed, superior probably to that which could have been had from other and more elaborate appliances. While this is in no sense an argument against the lightning arrester as ordinarly constructed it is certainly interesting to those who have to maintain long-distance high-tension transmission lines, and it suggests an easily applied and obvious remedy for many of the troubles that have beset such installations. Of course, it is not possible to use barbed wire in all situations, and there is a wide field for the lightning arrester ; but for the cross-country line it seems that the experience of the Chambly-Montreal line has shown that the barbed wire is perhaps the best protection yet discovered, and certainly the simplicity and ease of application of this form of lightning guard will commend it."

## QUESTIONS AND ANSWERS

"R. F.": What is the difference between priming and foaming?

Ans.—Priming is the name given to that state of the boiler when the water is picked up, in the form of spray, by the steam, and carried over to the engine or other machinery in which the steam is being used. It is caused by too heavy a demand being made on the boiler for steam, or by the steam spaces and channels being too small for the amount of steam required to be passed through them, and may exist in a boiler supplied with the cleanest water, whereas foaming is due to dirty water and consists of a violent agitation of the water in the boiler, due to the presence of impurities, such as grease and salts. Both are dangerous to the engine because they are likely to result in water getting into the cylinders, with all its attendant disastrous results ; and to the boiler because they are likely to result in low water and overheating of the boiler plates.

R. T. Davis : What is the usual rule for figuring out the capacity of the engine for driving electric dynamos?

Ans.—Dynamos are usually rated in kilowatts output, a kilowatt being, as the name indicates, 1,000 watts, and as a horse power is 746 watts, every kilowatt output from the dynamo is equivalent to $1\frac{1}{3}$ h.p., the input to the dynamo being greater than this by the losses in it, or say, five to nine or ten per cent. larger. If the engine and generator are direct connected, the input into the generator is the output from the engine, which is the figure required to be found, but if the two are belted, it will have to be further increased by an amount corresponding to the losses in the belts, which will be another seven to fifteen per cent., depending on whether or no countershafting is used. After we have found by the foregoing the engine power required to drive the dynamo at its rated full load, it is usual to take into consideration the question as to whether the unit is likely to be called on to carry any sustained overloads; if they are likely to be but temporary, and unusually close speed regulation is not imperative, the engine, having a wide margin in its cut off, is generally quite able to carry them without difficulty, if of the horse power (at normal cut off) given by the above rules.

"J. M.": I have a compound wound dynamo lighting our shops, and want to arrange it to run as a motor and help the engine at short intervals during the day; what changes will be necessary to make in the connections? What horsepower can I get from it? Its capacity is 500 lights.

Ans.—If you desire to run anywhere near the full capacity of the machine, it will be necessary to provide a switch which will either short circuit or else cut out entirely the series field coils ; if left as they are the machine will in all probability tend to spark badly and to run too fast. You will have to provide a starting rheostat in addition to the field rheostat, with which we presume you are already equipped, and also a switch for bringing the circuit from which you are going to run it to the motor, provided you have not already got one in for throwing the lights onto this foreign service instead of your own machine. If you have a switch which performs this service you can by charging the connections slightly make it do the work without going to the expense of adding others. If the lamps you are running are of 60 watts, the machine as a dynamo runs an output capacity of $500 \times 60 = 30$ kw., which is also its input capacity as a motor, the output capacity as a motor being from 12 to 8 less, depending on the efficiency of the machine, which will likely run somewhere from 88 to 92 at full load, depending on the make and age, and taking 10 as an average figure, will give you a 27 kw. or 36 horse power as the net output of the machine when operated in this manner.

"Student": What is the object in installing storage batteries where generators are already in use?

Ans.—Storage batteries are usually installed for one of three reasons : first, to obtain an absolutely steady voltage ; 2nd, to assist the generators over the peak of the load ; 3rd, to lessen the operating charges of a plant by lowering the wage account. The plants installed for the first service are as a rule small and comparatively unimportant from a commercial point of view, being used for calibrating instruments or for research work. Batteries installed under the second heading are put into those plants whose power or lighting load is at its peak, beyond the capacity of the generators installed, though well within their output at other times, in which case the batteries are charged during the hours of smaller demand and discharge in parallel with the machines at the peak. The same holds true of railway work, which to-day is perhaps the storage battery's greatest field, with the exception that as the demand on the bus bars varies tremendously from minute to minute the battery is in like manner continously being charged or discharged simultaneaously, with a falling or rising demand from the feeders for current, the object in both types of service being to reduce the generator capacity which would otherwise be necessary, and to keep the load on them and their driving engines as nearly uniform as possible, a necessary condition of maximum or even good economy. Plants put in under the third heading are generally left alone during the night hours to take care of the small number of lights which are usually required during that time without the necessity of paying an attendant to be present, as would be the case were engines and generators to be kept running during that time.

## CONVENTION OF OLD-TIME TELEGRAPHERS.

TWENTY-FIRST ANNUAL RE-UNION OF THE OLD-TIME TELEGRAPHERS' ASSOCIATION AND THE UNITED STATES MILITARY TELEGRAPH CORPS.—PIONEERS RELATE MANY INTERESTING REMINISCENCES.

The "pioneers of telegraphy," to the number of several hundred, gathered in the city of Montreal on Wednesday, September 11th, the occasion being the twenty-first annual meeting of the Old-Time Telegraphers' Association and the United States Military Telegraph Corps. For the first time in the history of these societies the meeting was convened outside of the United States, this to mark the "coming of age" of the societies and in recognition of the number of members who are now located in Canada. The membership of the Old-Time Telegraphers' Association is upwards of one thousand, and embraces many telegraphers now prominent in other walks of life. The United States Military Telegraph Corps is composed of veteran telegraphers who were engaged as army operators during the Civil War.


CONVENTION OF OLD-TIME TELEGRAPHERS' ASSOCIATION, MONTREAL, SEPTEMBER, 1901.

The programme of entertainment furnished by the local committee was of an excellent character, and such as to prove the ability of Canadian cities to entertain in an equally hospitable manner with the cities of the United States. Mr. L. B. McFarlane, president of the Old-Time Telegraphers' Association, received the hearty support of a large committee, and had made every arrangement for the entertainment and comfort of the visitors.

The opening proceedings consisted of an informal social meeting of the members of both societies in the Ladies' Ordinary at the Windsor Hotel. Col. William B. Wilson, president of the Military Telegraph Corps, presented Mr. L. B. McFarlane with a souvenir badge, formerly owned by inventor Morse and donated to the Association by Mr. J. Reid.

Mayor Prefontaine welcomed the visitors to the city in an appropriate address. Col. Wilson replied, thanking the Mayor for the hearty welcome that had been extended to them, whereupon the Mayor was made an honorary member of the association.

Business sessions were held during Friday. The project to establish a Telegraphers' Home was discussed, and it was decided that it was not expedient for the association to undertake the building of a home at the present time. It was decided to hold the next annual meeting at Salt Lake City and Ogden.

The Telegraphers' Association elected the following officers: President, George H. Corse, of Ogden; vice-president, Belvidere Brooks, of Denver, Col.; secretary-treasurer, John Brant, New York.

The Telegraph Corps re-elected its officers for the coming year: President, Col. William B. Wilson, of Philadelphia; vice-president, William M. Ives, New York; secretary-treasurer, James E. Pellit, Chicago.

The visitors drove around the city and up to the mountain during the afternoon, and were entertained to luncheon by the Mayor.

Thursday and Friday were devoted to pleasure. Visits were made to the electric lighting and power stations and a trip was taken on the steamer "Duchess of York," shooting the rapids and making an inspection of the harbor of the city. Owing to the unfavorable news received from the bedside of the late president McKinley, it was decided to cancel all appointments made for Friday afternoon. Some of the delegates made the return trip by steamer to Quebec.

### THE BANQUET.

The feature of the convention was a banquet held in the Windsor Hotel on Thursday evening. This was a most pleasant and successful function. Mr. W. C. Burton, of New York, presided. On the walls were the names of Morse, Galvani, Edison, Thompson, Faraday, Ohm, Reid, Bell, Franklin, Volta, Preece, Wheatstone; and facing the chairman were the words "Old-Time Telegraphers, '73." In the centre were the union jack and the stars and stripes, while flags of many nations were tastily arranged around the windows. The menu was excellent and served in an admirable manner. Toasts were drunk in honor of King Edward and the President of the United States, following which came several informal speeches.

A talk on "Old-Time Reminiscences" was given by Mr. H. P. Dwight, of Toronto, the general manager of the Great Northwestern Telegraph Company and the father of Canadian telegraphy. Mr. Dwight said:

"I have never, until now, found it convenient to attend any of the meetings of the Old-Time Telegraphers' Association. As it was arranged that the meeting this year should be held in this grand old historic city of Montreal, and as it was here that I began my

career as a telegraph operator fifty-four years ago, and as the time has arrived when I presume there can be no doubt as to my qualifications as an Old Timer, I thought it a duty, as well as a pleasure, to be present on this occasion. Looking around the table reminds me of what I have sometimes noticed in connection with some "Young Men's" Associations, the members of which are often old and gray-headed, and sometimes bald-headed men. Our "Old Timers," I should judge by those I see around the table, are some of them what might be called comparatively young men. That, however, depends altogether upon the point of view. When I was twenty or twenty-five years of age, or thereabouts, I thought a man of forty or forty-five a pretty old man, but as I grew older myself, I gradually changed my mind as to the old age date, until I have now come to think that a man of even seventy or seventy-five years of age is not a very old man after all, and a man of forty or thereabouts a mere boy. The younger men present, however, who may be disturbed as to their qualifications for membership in the Old-Time Telegraphers' Association on the score of age, need not worry about the matter. You will wake up some morning before long, my young friends, and be surprised to find that you are seventy years of age, and you will begin to think that there must be some mistake about the matter; and you will hunt up the old family Bible to see about it, and you will find the "Gospel Truth."

"The newspapers are beginning to refer to me as "The Father of Canadian Telegraphy," and I do not hesitate to say that I am very proud to be so called. I confess that I am, in fact, vain of the title. But if I am in any sense the "Father of Canadian Telegraphy," the "Grandfather" is Mr. O. S. Wood, who was Professor Morse's first pupil, and was the first superintendent of the Montreal Telegraph Company, and is still living in retirement, a useful and honorable life—85 years of age—one of the purest and best of men, honoured and beloved by all who know him. We might take him for our Patron Saint. I said that I was glad to be called "The Father of Canadian Telegraphy." Every man is proud to be the father of a numerous and respectable family; and I can point with pride to the numerous progeny in the business who have grown up under me, occupying respectable and prominent positions, not only on the lines under my charge throughout the Dominion, but on other lines in Canada and in the United States—to say nothing of others who have left the service, and are filling honorable positions in other walks of life. It has been a great pleasure, and I have been very proud to hear, as I have done from time to time, favorable reports from telegraphic superintendents in the United States of our Canadian operators in their service.

"This is not the time or place, however, for long speeches; and I have little more to say. I don't know how my brother Old Timers feel, but for my part, I feel a very great pride and satisfaction in having been connected with an enterprise which we may proudly claim to have done more than any other to facilitate the business and promote the comfort and happiness and peace of the world; and I take this occasion to congratulate every Old Timer present, who is still or has ever been connected with the business, on such an honorable and useful service as it has been our good fortune to be engaged in.

"I hope our brother Old Timers from the other side of the line have been pleased with their visit to the Dominion, and to Montreal. We think we have one of the best countries on the face of the earth; I will not say the best, because I would not like to be lacking in politeness to our freinds by saying that we have a country better than their own. These international gatherings serve a much wider purpose than merely social intercourse, in promoting the friendly relations between Canada and the United States. It is pleasant to know there is such a friendliness, and that it is constantly increasing. In fact, "Uncle Sam" and our "Lady of the Snows" are getting to be very intimate, and judging from all that we see, the more they know of each other, the more friendly they are likely to become. Nowhere in the civilized world was the news of the attempted assassination of President McKinley received with greater horror and indignation and sympathy than in Canada, and Canadians are proud to-day in knowing that a Canadian physician and Canadian nurse are at President McKinley's bedside. "One touch of nature makes the whole world kin."

"What the ultimate result may be, it is hard to say; but it would not be surprising if, sooner or later, "Uncle Sam" might be found to have serious intentions—probably a proposal may be made! If matters ever reach such a point, I think I can tell pretty well what the reply of our "Lady of the Snows" is likely to be. I fancy it would be something to this effect: "Uncle Samuel, you are very good looking, and are very smart, and you are prosperous, and all that, and I feel greatly flattered; and I have no hesitation in consenting to be your sister." The fact is, that "Uncle Sam" and our "Lady of the Snows" are getting to be about as familiar as they can well be, without occupying the same apartment; but I am afraid that our "Lady of the Snows" will draw the line there."

Mr. William Maver, of New York, followed with a short address as an Old-Timer and a Montrealer. Thirty years ago he travelled every street in Montreal, as a messenger, at one cent a message. The line of promotion was from messenger boy to delivery clerk and then into the operating room. He referred to the great difference in the systems of old Montreal and those of to-day.

Mr. M. J. O'Leary, secretary of the Telegraphers' Mutual Benefit Association, spoke of the greatness of fraternalism, and Hon. A. M. Mackay, general superintendent of the Anglo-American Telegraph Company at St. John's, Nfld., followed as one of the oldest of Old-Timers. Mr. Mackay has been in the employ of the Anglo-American Cable Company for forty-five years. He was formerly an operator of the Montreal Telegraph Company and claims to be the first man to take a message by sound. He spoke as follows:

"I may be characterized as an "Old-Timer," because my connection with the telegraph dates from the 4th of June, 1850. I took charge of an office on the 12th of September of that year, so that our meeting here to-night is the anniversary of my fifty-first year of actual telegraphy (applause). One month afrerwards I dispensed with the use of paper in the Morse instrument. It has been claimed that another person had already dispensed with paper in that connection. If there was another person prior to the 14th of October, 1850, that copied messages by sound, he is prior to Mr. A. M. Mackay; if he is subsequent to

that date, then he is subsequent to Mr. A. M. Mackay, (applause). I came to Montreal in 1854, but before getting permission to work I was permitted to undertake the duties provided I would permit an overseer to see that I made no errors in receiving by sound.

"I will now, if you please, refer to a matter more interesting to you all. I mean the Atlantic Telegraph, a subject that always occupies a large share of attention, because telegraphing by cable is one of the most important factors of the whole service that makes the telegraphy of the world so valuable. The subject I want to mention to you is the question as to "who was the person that initiated or gave birth to the idea of an Atlantic Telegraph, and to all deep sea and long distance telegraphy?" Where this subject has been given attention it is claimed that the Rev. Dr. Mulock, Roman Catholic bishop of Newfoundland, was one of the parties. Others contend that the late F. N. Gisborne is the person, and others that Cyrus Field should have the honor. I would refer to these three gentlemen, beginning with Dr. Mulock. My opinion should be worth something, as I am the only living man of those connected with the Atlantic cables at their inception in an executive capacity. There is not the least doubt that Dr. Mulock got his information from Mr. Gisborne, and that his only connection with telegraphy was the expression of his belief in the possibility of its establishment. There is no doubt in my mind, therefore, that the honour lies between F. N. Gisborne and Cyrus Field. Gisborne's friends contend that he was unjustly treated by Mr. Field, and that he really advised Field of the possibility of accomplishing this great work. Mr. Gisborne did not make that contention in his lifetime. I saw him long subsequent to the establishment of the Atlantic Telegraph, and he said that on meeting Cyrus Field in January, 1854, while foreshadowing the possibility of establishing Atlantic communication between Newfoundland and the continent of America, he did not refer to a cable to England, but only relied on the success of that enterprise by contributing messages from steamers arriving from Newfoundland and transmitted from Newfoundland by carrier pigeons, and ultimately by telegraphic cable. Gisborne made this statement, and admitted that he did not on his first interview with Cyrus Field foreshadow the possibility of the Atlantic Telegraph.

"Mr. Field being questioned in regard to that interview, which took place in 1854, said exactly the same thing. He only contended for the pigeons in the first place, and the possibility of a cable to Cape Breton in the second place, and he considered that there was no possibiliy of such a scheme ever paying, and, therefore, he would not have anything to do with it. But on seeing Gisborne he turned over the Globe, and seeing that Cape Breton was only an inch or two on the globe from Newfoundland, and Ireland only six inches, he said at once "if a cable could be laid to Cape Breton, why not to Ireland." The next morning he wrote Professor Morse and asked him if a cable could be laid to Ireland whether it could be worked. Concurrently he wrote to Lieut. Morley, of the United States Navy, and asked him if it would be possible to lay a cable to Ireland. Satisfactory answers being obtained to these two questions, he at once embarked in the enterprise, and threw his whole influence into the work of laying the Atlantic Cable. Gisborne did not communicate the idea of an Atlantic cable, but he communicated the idea of a cable. That was enough for a man of Field's foresight and ingenuity. So there is really no difference as to the credit due these two gentlemen for the initiation of the project. I think I am the only living witness to these facts, and I am glad to have this opportunity to state it publicly.

"Who, then, was the author of the first idea of the Atlantic Cable? In 1854 the New York, Newfoundland and London Telegraph Company obtained a charter with exclusive rights to land a cable in Newfoundland. I am confident that this exclusive right will never be renewed, as I am sure that the British Government will never consent, now that deep sea telegraphy is an assured fact, to exclusive rights of that nature being conferred on any corporation. I find no difficulty in naming the man who first started the idea of an Atlantic cable. Mr. Gisborne in 1850 showed me letters at that time from Mr. Brett. There were two Bretts. I think the first was John and the second Jacob, but it was the older Brett who was in communication with Mr. Gisborne, and he had given birth to the idea of a cable. He not only gave birth to it in 1850, but in 1852 laid the cable from Dover, in England, to France, and that cable was working until within a few years of the present time. He not only gave birth to the idea, but gave actual presence to the cable, and I think it is not unlikely, and I find it easy for me to say that there never was an inventor who was wont to appreciate his own invention. I think it is not unlikely that Brett, when he had the idea of a cable at all, although only 21 miles in length, that he had within his vision thousands of miles, covering all waters and all seas. My idea is that John Brett was the originator and inventor of the submarine cable.

"Colonel Wilson has made reference to the fixity of purpose, the absolute security, and the trustfulness that it put in telegraphers. I think it is fair to all the telegraphers with whom I have been connected, having passed under my supervision millions of telegrams within the last 51 years, and I have never known one single instance where the trust in a telegrapher has ever been betrayed. (Prolonged applause). There has not been a single instance in all my life where I have had the least knowledge or suspicion of a message having been wilfully divulged.

"It has been a great pleasure to me to come here on this occasion, and my anticipations have been more than fully compensated. I have by virtue of the Association badge taken the liberty of speaking to many ladies without an introduction, and I must say that they have treated me with the greatest courtesy and kindness the same as if they had known me, relying on my membership, and probably on my ancient and respectable appearance. (Laughter and applause).

Brief but clever speeches were made by Col. D. W. Wilson, of Philadelphia; Senator Ives, vice-president of the Military Telegraph Corps; Mr. W. McLea Walbank, manager of the Lachine Rapids Hadraulic & Land Company, and W. C. Burton, of New York.

The proceedings of the evening were dispersed with songs. Messages were received and read at the banquet from the president and the vice-president elect acknowledging the honor which had been done them.

Mr. John Horn, of Montreal, exhibited many valuable telegraphic relics which he has in his possession, including original letters ánd telegrams written by "Father" Morse.

## AWARD FOR AN ELECTRICAL EXHIBIT.

On this page is shown a fac-simile of the certificate accompanying the Gold Medal awarded to the Canadian General Electric Company, of Toronto, by the directors of the Toronto Industrial Exhibition for their very comprehensive exhibit at the recent exhibition, which was illustrated in our September number. An interesting feature of the Medal is that it bears on its face the words "In Commemoration of the Accession of Edward VII, Rex. et Imperator, 1901." It was, of course, in view of the change necessary to make a special die for this year's issue of medals, but by doing so they are distinct from every other issue. It is understood that this is the first time that a Gold Medal has been awarded by the Toronto Industrial Exhibition Association for an exhibit of electrical apparatus.

## PERSONALS.

Mr. J. J. Franklin, some years ago manager of the Montreal Street Railway, died in Toronto last month, at the age of 54 years.

Mr. S. Sotomayor, of Chile, South America, has been in Canada recently looking into the utilization of water power for electrical purposes. In Chili, notwithstanding that there are abundant water powers, they have been employed but very little for electrical purposes.

Mr. F. W. Martin, superintendent of the Hamilton Electric Light & Cataract Power Company, has been appointed manager of the Lincoln Light & Power Co., of St. Catharines. Mr. Martin is held in high esteem by the officials and employees of the Cataract Power Company, and upon tendering his resignation he was presented with a handsome gold watch and chain and a Masonic charm. The presentation was made by Mr. Gordon J. Henderson, superintendent of the lighting department, and was acknowledged in words of appreciation by Mr. Martin.


## BY THE WAY

In the entrance to the Electricity Building at the Pan-American Exhibition are displayed a number of "first" things in electrical devices. Among them is an arc lighting machine, labelled "First Arc Machine used for public lighting—date unknown." I am told that the machine was manufactured in Philadelphia by Mr. J. J. Wright, now manager of the Toronto Electric Light Co., and that on one of the brass set screws may still be seen his mark made with a file at the time the machine was manufactured. Mr. Wright could no doubt supply the missing date and in addition much interesting historical matter relating to this and other devices invented by himself, Prof. Elihu Thomson, and other pioneers of the electrical industry. But his well-known modesty forbids.

Mr. George C. Rough, manager at St. John, N. B., for R. E. T. Pringle, of Montreal, has been suceeded by Mr. Irving Smith, who for some years was with the Canadian General Electric Company.

## TRADE NOTES.

The Electric Repair and Contracting Company, Montreal, Que., recently installed the wiring for 150 lights for the Royal Shoe Company and 230 lights for the Geo. Slater Shoe Company, Maisonneuve, Que.

John Forman, dealer in electrical apparatus and supplies, Montreal, Que., supplied all the Imperial transformers for the recent electrical illuminations in Quebec, over 13,000 lights being used. These transformers are manufactured by the American Transformer Co., New Jersey, Mr. Forman having the Canadian agency.

Messrs. Munderloh & Co., manufacturers of electrical supplies, Montreal, have just issued a neat and attractive bulletin illustrating their new "Solar" alternating current multiple arc lamps. This company claim the Solar lamps have given universal satisfaction wherever installed, and that they are being placed where most other alternating current multiple arc lamps failed to give satisfaction. They are handsome in appearance, well made and efficient.

During the recent illuminations in Montreal the Sayer Electric Company, in their arrangement of lights on the buildings entrusted to them, did some of the best work done in the city. As a proof of this the following buildings and houses may be mentioned: City Hall, Canada Life Building, St. James street; Star Building, Bank of Toronto Building, residences of R. Wilson-Smith, Sherbrooke street, H. Graham, Sherbrooke street, R. Stanley Bagg, Sherbrooke street, and G. H. Burland, Sherbrooke street.

# ELECTRIC RAILWAY DEPARTMENT.

## A ROYAL TROLLEY CAR.

Upon the occasion of the recent visit of the Duke and Duchess of Cornwall to Ottawa, they were transported from Rideau Hall to the Chaudiere in a trolley car provided by the Ottawa Electric Railway Company expressly for the use of their Royal Highnesses. It is fifty feet in length, straight sides, and vestibuled at both ends, with full monitor roof of the Pullman pattern. The color is also Pullman standard, with the British coat-of-arms in gold conspicuous on both front and rear.

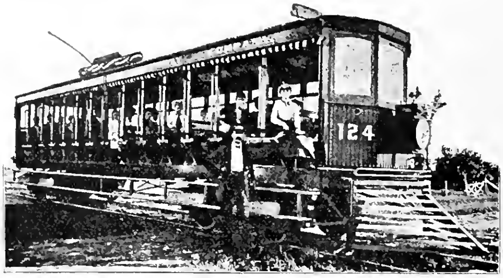
The interior of the car, shown herewith, is finished in antique polished oak, the ceiling being covered with three ply bird's eye maple veneer, and decorated. There are four large British plate mirrors set in frames, two at either end of the car. All trimmings, such as hat racks, hooks, etc., are of solid bronze. The window curtains are of the latest design, and are very ornamental. The car is brilliantly illuminated by five clusters of incandescent electric lamps, twenty-one in all. The floor is covered with a rich, Royal blue velvet carpet. The car contains fourteen large easy chairs beautifully upholstered in olive green plush. The trucks are double, and of the swing motion pattern

INTERIOR ROYAL TROLLEY CAR.

with graduated springs. The electric equipment is very complete, and consists of four Westinghouse 50 h. p. motors. The car is also fitted with the Westinghouse automatic air brake, and is capable of attaining a speed of fifty miles an hour. It was manufactured by the Ottawa Car Manufacturing Company.

## NEW TYPE OPEN CAR.

A new style of open car has been in operation the past summer by the Montreal Park & Island Railway Company, of Montreal, and the London Street Railway Company, of London, Ont. It consists of a 15-bench open car, one side of which is the same as that of a closed car. It has a seating capacity for 75 persons. It is geared to run at a speed of 45 miles an hour, and is mounted on double trucks of the company's standard, which are equipped with Westinghouse 38 B motors. The length of the car over all is 43 feet 6 inches, width about 7 feet, and height from floor to ceiling 7 feet 6 inches. On one side the car is closed to a height of 3 feet 3 inches from the floor, and the upper part of this



NEW TYPE OF CAR.

side contains sashes making two half windows, the upper panels being stationery and the lower ones opening upwards. The other side of the car is entirely open. A view of the open side is herewith shown.

Grab handles are placed on each post on the open side of the car, and each seat is also supplied with a grab handle. The seats are 18 inches high with a 15 inch face, with side frames filled in with strips of 3/4 by 1/4 inch maple. A foot rest is provided under each seat, and a steel panel supports each seat on the step side of the car. On the closed side the seats are supported from cast-iron brackets on the posts.

The Stirling brake is used on one end of the car only. The lighting consists of a centre 5-light cluster and a 4-light cluster at each end, one light in the rear vestibule and one for the head light.

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Messrs. Clarke Bros., of New York, and Thomas Meaney, of Toronto, are about to develop a water power on the St. Marguerite river, seven miles from the village of Seven Islands, in the province of Quebec. It is the intention to build a large pulp mill and to employ electricity for the operation of certain machines and a short railway. The company has agreed to expend $500,000 within two years. Henry Holgate, of Toronto, is consulting engineer for the hydraulic work.

Satisfactory progress is being made with the building of the plant of the Cascade Water, Power & Light Company, Limited, situated on the main Kettle river at Cascade, B.C. A dam has been constructed at the head of a rocky gorge, which raises the water to a height of 36 feet above the natural level, and gives a working head of 156 feet at low water. The dam is of timber cribwork filled with rock and 400 feet in length. The water is conveyed from the dam to the power house first by an open rock cut 225 feet long, then by a tunnel 400 feet and again by another open channel for a distance of 500 feet. The power house will be placed on at natural bay a the foot of the falls. The turbines will be of the horizontal type, two wheels in each case, and the generators, supplied by the Westinghouse Company, will be three-phase alternating type, while step-up transformers will be used to raise the current for transmission.

## DEVELOPMENT OF ARC LAMPS.

The history of the arc lamp has been a story of improvement, and the tendency in construction has of late taken a decided turn toward the use of the fewest parts possible consistent with reliable operation. The result of this has been the production of arc lamps that are models of simplicity in mechanical construction and electrical design. For many years after the advent of commercial arc lighting the manufacturing companies, while exercising any amount of effort and skill in the perfection of generating apparatus, seemed strangely oblivious to the shortcomings of arc lamps. Any combination of magnets, levers, wheels and springs that would separate the carbons and feed them together again with any degree of regularity, was considered as fulfilling all requirements for an arc lamp.

FIG. 1
ALTERNATING CURRENT CONSTANT-POTENTIAL ENCLOSED ARC LAMP.

Recently, however, many important improvements have been made to this much neglected piece of apparatus. After a ssries of exhaustive experiments and tests, a constant direct series enclosed arc lamp has been evolved by the Adams-Bagnall Electric Co., of Cleveland, Ohio, which is a model of simplicity of design and excellence of construction, and which appears to fulfill every requirement of modern arc lighting. One of the most vital parts of an arc lamp is its cut-out. The Adams-Bagnall have produced a construction that is unique and effective and one which actually improves the more it is used. It consists of a bar loosely pivoted in its center to the upper end of the armature of the regulating magnet. One end of this bar carries the contact, which is of coin silver; the other end is shaped to form a contact of large service for carrying the volume of current. In operating, these silver contacts meet first and cut out the lamp, when by the combination of the motion of the armature, due to gravity, the finished brass surfaces are brought into contact for carrying the greater part of the current. As the silver contacts close first and open last, the sparking is entirely confined to their surfaces; the brass surfaces do not corrode by the action of the lamp. This is only one of the many improvements which have


FIG. 2
SHOWING OUTER GLOBE READY FOR TRIMMING.

FIG. 3
SHOWING LAMP CASE OPEN FOR ADJUSTMENT.

been made to the ordinary arc lamp, and the successes which it may be expected to attain in the future is attested by the fact that the Ottawa Electric Company installed last year 600 lamps of this pattern; and in the city of London, Ont., 350 are now in operation. This firm manufacture twelve varieties of arc lamps, including alternating current, constant potential, enclosed arc lamps as well as direct current, constant potential, enclosed arc lamps.

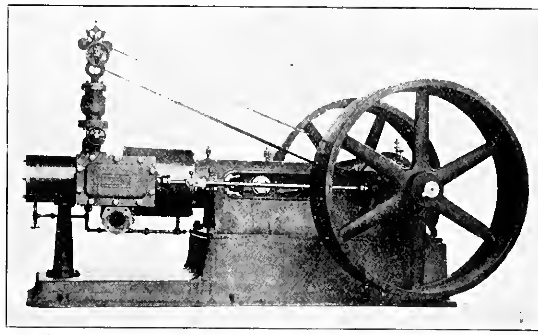
## THE HARDILL COMPOUND ENGINE.

The town of Mitchell, Ontario, presents an example of Canadian enterprise in the possession of a company who are meeting with success in the manufacture of a compound steam engine invented and perfected by purely Canadian genius.

Mr. Joseph Hardill succeeded in January, 1899, in obtaining the Canadian and United States patents on a new design of cylinders and valves for a compound engine which had occupied his attention for a number of years. Considerable interest was hereby manifested among experts, who recognized in this design the possibilites of an inexpensive, yet complete and serviceable engine presenting promise of increased economy, besides other features heretofore unobtainable, at a price which would be within the reach of all steam users, and at the same time be so free from all complicated parts and gears that it could be operated by anyone capable of handling an ordinary slide valve engine.

An engine was accordingly built and sent to McGill University, where it was subjected to an unusually thorough and practical test, and although the engine was the first of its kind, the results, we understand, were gratifying beyond the fondest expectations of its builders, who were congratulated on their possession of a most valuable invention.

A company was then formed and incorporated under the name of the Hardill Compound Engine Company, of Mitchell, Ont., Limited, who immediately made preparations for placing the engine on the market, and have been working quietly for a little more than two years, perfecting designs and building patterns, so that to-day, as all who attended this year's Exhibition at Toronto will agree, they have succeeded in producing an engine



THE HARDILL COMPOUND ENGINE.

which for performance and appearance is of exceptional merit.

In the meantime a number of engines had been sold, and may be found doing almost every conceivable kind of work, and giving such general satisfaction that the success of this engine seems assured. The company are now prepared to supply this engine in all sizes, from 15 h. p. to 100 h. p., with the assurance that every engine will fulfill the claims made for it.

A company has recently been organized in Buffalo who are building the same engine and meeting with the same degree of success. One of their engines was tested at Cornell University, and its performance was such as to call for the most flattering commendations. It is hardly necessary to state that these two universities are equipped with special facilities for making such tests in a most thorough and vigorous manner, and that their reports are comprehensive and absolutely impartial.

The Hardill compound, of which an illustration is shown, is a compact, self-contained, medium speed engine of the tandem compound type. It may be operated as a double-acting or single-acting compound as may be required. The peculiar feature is the two-valve chests, one on each side of the cylinders. These chests form the bulkhead and are cast in the same piece with the cylinders, giving great rigidity to the structure. Each valve is complete in itself and independent of the other, being operated by separate eccentrics so that either may be shut off at discretion without impairing the operation of the engine, in cases where half or less than half the usual power is required. The valves are extremely simple and compact, and themselves form the means of conveying steam from the high pressure cylinder to the low pressure cylinder without the aid of a receiver or any other connections. This is in itself a strong recommendation, in addition to the fact that the steam from the high-pressure cylinder, before being admitted to the low-pressure cylinder, must pass through the valve which is at all times surrounded by live steam, thus preventing condensation and insuring the desired result of greater economy.

The makers are desirous of having the public become acquainted with this new engine, and will gladly correspond with all who are interested in a reliable and economical engine at a reasonable cost.

# ENGINEERING and MECHANICS

## OILING CRANK PINS, WRIST PINS AND GUIDES OF STEAM ENGINES.

By W. H. Wakeman.

The plan of oiling a bearing that is in motion (like the crank pin of an engine) from a stationary oil cup, is now so commonly practised that it attracts little or no attention among engineers in large cities. But this was not always so; even now there are hundreds of engines running without this great improvement, and there are still a few engineers who do not appreciate the value of such a device. The word "few" here means several thousands, for it is used in a comparative sense only; the total number of engineers in this country is very large.

From the time that I first opened the throttle valve of an engine until the present day, it has been my ambition to keep my engine running at full speed for the required number of hours, whatever that might be, from the mill that runs but five hours without a stop to a run of 132 hours without closing the throttle valve. During the first six years of this time I did not have any way of oiling my crank pin while in motion, except a cup that revolved with the crank. I am free to admit that the care necessary to keep that pin from heating was greater than that caused by all the other bearings combined, for I could fix them while running, but any mistake in setting that crank pin oiler was sure to bring the whole mill to a standstill before the appointed time.

The oiler consisted of a common brass cup screwed into the strap on the connecting rod, with a tube in the center through which a piece of lamp wicking was drawn. When this was new it would feed too fast; when it had been used a few weeks it fed just right, and after that it fed too slowly, provided it was not taken care of, so that the adjustment consisted in manipulating this piece of wicking every morning and noon so as to overcome its exasperating tendency to feed too much or too little; but the rule followed was made up from day to day, so that it is impossible to repeat it here.

On the second engine that I engaged to run, a very similar device was used for the crank pin. I soon discovered that this shop contained machinery that could not be stopped at pleasure without damaging the stock used, hence the crank pin became more important than ever in my estimation. I decided that a "wiper" was necessary, but wipers were expensive at that time, and as I was anxious to make as good a record as possible in the cost of running the plant, I had one made. A neighboring blacksmith forged out a piece of iron and punched a large hole in it, so that by taking one of the capscrews out of the main bearing, putting it through this hole and returning

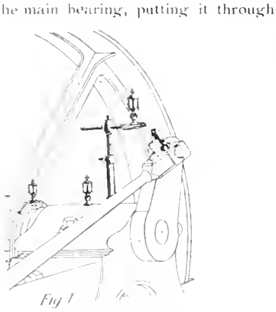


Fig 1

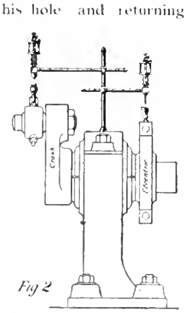




Fig 2

capscrew to its place, I had a standard that answered the same purpose as that shown in Fig. 1. A piece of sheet brass was fitted into the cup on the strap, a sightfeed oiler put on the standard, and other details attended to that made it possible to run that engine as many hours as required without shutting down to oil the crank pin. I am not advocating the idea of making such devices to the exclusion of those put on the market by reliable parties, for the ones sold in competition with others in the open market are nearly always better than any "home-made" device. As a rule they are cheaper, too, all things considered. I am not in sympathy with the man who uses $6.00 worth of time and $1.50 worth of stock in making an article he could buy for $5.00, and then boasts of his business sagacity. I do claim, however, that where an engineer can not induce his employer to purchase some needed appliance, he is justified in making it, provided it is not patented.

The wiper shown in Fig. 1 has a piece of flat lamp wick stretched in a horizontal position underneath the sight-feed oiler; as the oil is dropped on this it filters through and is wiped off from the under side by the moving cup. Fig. 2 is all metal, the oil falling through a slot and hanging underneath until the wiper comes around and takes it off. This illustration shows the same device in use on the eccentric engine. While this is not absolutely necessary on a slow-speed engine, it is a very good thing to have in use.

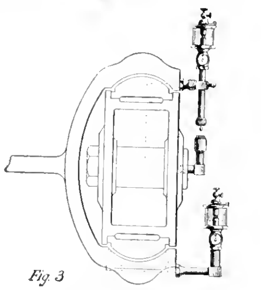


Fig. 3

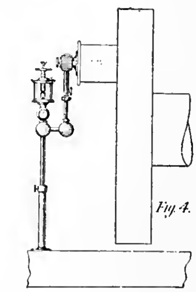


Fig. 4.

Fig. 3 shows a wrist pin oiled in the same way, also a cup that feeds oil to the lower guide. The dotted lines show how the oil rises to both edges of this circular guide, thus insuring lubrication for the highest parts of it, after which the oil is sure to work downward to the lower part without further attention. Fig. 4 illustrates another device for oiling a crank pin while in motion. The principle on which it operates is the use of centrifugal force. The sight-feed oiler drops oil into the hollow ball beneath it, out of which it flows to the right and drops into the hollow ball which revolves opposite the center of the crank shaft. So long as it remains at the center there is no tendency to go in either direction, but when the crank is down the oil moves away from the center, and once started on its journey it quickly travels toward the crank pin without regard to the position of the crank. It is quite a job to apply this form of oiler to an engine in a mill, as two holes must be bored in the crank pin, but it is very satisfactory in practice, because it throws the oil less than any other device. The same principle is utilized on some center-crank engines, where oil is taken from oilers on the shaft bearings, and used in the same way.

Having described these oilers, I wish to call attention to their great value to steam users, not only on account of preventing lost time in shutting down during working hours, but because they deliver oil to the rubbing surfaces in small quantities and at regular intervals. It is quite possible for these surfaces to wear much more than is necessary without heating or giving any outward indication except that the keys need frequent adjustment and the boxes are worn out sooner than they ought to be. Some mill owners regard such devices as luxuries, therefore they can be dispensed with; but this idea is not wholly correct, for while a mill can be run without them it does not pay to do it. It seems rather inconsistent to find a mill in a city, near machine shops and other places where repairs are made, fully equipped with oilers that prevent friction and wear, and then to find another mill located several miles from the nearest machine shop (which may be a primitive affair at best) fitted with oilers that do not prevent the bearings from becoming warm every day. In such places repairs are always expensive, since it takes so long for one or more machinists to reach the place.

The only objection to wipers on the crank pin and wrist pin of an engine is that they call for oil cups, or rather oil-catchers, that are open on the top, and when located in a dusty mill there is a chance for some of the flying dust to get into the open cups and clog them, or work down into the bearings and damage them. This objection may easily be overcome, how-

ever. A small piece of waste put loosely into each one will allow the oil to filter through it, but will catch the particles of dust. It is necessary to renew these pieces of waste frequently in order to prevent them from becoming hard enough to stop the oil from filtering through fast enough to keep the bearings well lubricated. This is but a small job, and need not be done more than twice each week.—The Wood Worker.

## CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

### HAMILTON NO. 2.

THE first open meeting of Hamilton No. 2 took place on the evening of October 10th, when a paper on "The Metric System of Weights and Measures" was read by Mr. J. Gill, B.A., of the Collegiate Institute, Hamilton. The paper was very interesting, and the Association is to be commended on being the first to take up this subject.

### TORONTO NO. 1.

Editor ELECTRICAL NEWS:

Dear Sir,—At a meeting of the above Association held on Wednesday, September 15th, I was appointed correspondent to the Mechanical Press. We had a fairly good meeting; several questions being up for discussion, one regarding the respective merits of the Wheelock, Corliss and Brown engines. Each engine had its supporters, and from the points brought out it would be difficult to say which engine is the best.

At a meeting on October 2nd the Educational Committee reported that it was the intention to hold a series of open meetings on the third Wednesday of each month during the winter. The first will be held on October 16th, when a paper will be given by Bro. W. Bourne, superintendent of the Toronto Electric Light Company, on "Care and Management of Dynamos and Motors." A cordial invitation is extended to all who are interested in electrical engineering. Trusting that you will find space for this in your valuable paper, I am,

Yours truly,

H. E. TERRY,

Corresponding Secretary.

# MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS,
Imperial Building,

MONTREAL, OCTOBER 5th, 1901.

Although business has been rather quiet electrically during the hot summer months, when there was a considerable exodus from Montreal, it has now resumed its sway, and the outlook for the fall is very fair.

There seems to be little doubt but that the St. Lawrence Power Company, who tendered for the civic arc lighting in Montreal, (but lost it through no fault of their own), mean to do business in this city any way. The names they mention in their directorate ought to get them right of way via C. P. R. track land to Montreal, with the fair chance of doing some business at small villages along the route. Apart from arc lighting there is still a good field for them for motor and residential incandescent power.

Both the American and International Schools of Correspondence, each of which conduct electrical courses, have opened local offices in the vicinity of the corner of Windsor and St. Catherine streets.

The new distributing station for the Royal Electric Company is now pretty well built, and when completed will give them more scope to handle additional load. We understand the layout of this is in the hands of Mr. Marchand, formerly expert with the Westinghouse Company, but now employed by the Chambly-Royal combination.

It would be interesting to know, in the face of the elaborate systems for handling accounts described at one of the late C. E. A. conventions, why the Montreal Gas Company is able to handle a greater number of accounts than the Electric Company, and with less staff?

The Bell Telephone Company deserve great credit for one of the finest telephonic equipments ever produced and installed. We refer to the system they have lately put up in the Royal travelling train.

Some of the illumination devices for the royal visit were certainly worth comment. Referring to those on Windsor Hotel, which designs, we read in the lay press, were imported from England: Since when was it necessary to import from England the "stars and stripes," and why use it at all? It may be a desire to please American guests, but if so it was a very poor compliment, to say the least, to the city's Royal guest. There was no harm in Americans so honoring our prince, but Britishers surely can honor him by other means than by display of a foreign flag, even admitting the fact that it was a nice combination of colored electric bulbs. Another anomaly was the (so-called) Irish flag, consisting of the Union Jack in the left upper corner, green ground with yellow harp. Prettily lamped, we admit, but such incorrectness and lack of taste ought to cause our future king to smile if nothing more. This design surely was not "imported."

The Grand Trunk Railway depot was a neat bit of work, the illumination installation being done by the Royal Electric Company. This company installed thousands and thousands of incandescent lamps on many public buildings, principally "strip work," picking out the architectural beauties of the different buildings with good effect. Clear lamps were almost invariably used. Among the monograms, shields and like devices shewn, the Montreal Electric Company had some handsome combinations; the backgrounds being all neatly painted or gilded in "proper" colors and picked out with colored lamps to match. Columns might be written on the illumination question, but suffice it to say that every electric contractor and power supply company in Montreal was rushed. On the average good taste was displayed by the contractors with their designs, and it is safe to say the two evenings will be referred to by electricians here in days to come when the Duke is safely back in his own home.

According to the lay press, Tesla is again "promising things." Is it not nearly time for some one to sue that gentleman for "breach of promise"!

The Canadian Pacific Railway was patriotic enough to manufacture the cars for the Royal train in Canada; yet gave the illumination of their building for the Royal visit to an American (Boston) firm. "Shades of Sir John - what is patriotism?"—evidently dollars and cents.

Another municipality wants to try it. As Westmount (Montreal) got no answers to their request for tenders for municipal arc lighting, owing to the fact that the companies were then busy flying for bigger game, they now think they would like to emulate some Ontario towns by having their own plant. The success of such in the face of statistics is exceedingly doubtful, but as the suburb in question is apparently honestly governed, it is just possible they might succeed.

Here is an instance of charges for current during the visit of His Royal Highness the Duke of York. Minimum charge would be $50 for 100 lamps for the two evening's display. Let us compare this with meter ordinary rates: Say 4 hours per night = 400 lighting hours per night, or 800 lighting hours per two nights × ¾ cent per lamp hour = $6.00 less 33⅓% discount = $4.00 net. Rather a difference! Now, multiplying the regular rate by 12½ times, is good figures, and at such prices patriotism comes high. Although the public were prepared to pay higher than usual, there were many who deemed this extortion, and who promise to remember the fact when the proper time comes.

A New York newspaper correspondent writes his paper to the effect that Quebec had the site, but Montreal had the money, hence the illuminations were grander. So say all of us who have seen both, and it is exceedingly doubtful if any other city will have 40,000 additional lights going for His Royal Highness.

The public who use incandescent light in their homes are beginning to wonder whether they may not pay dearly for the late civic arrangement with the Royal Company of $60.00 per arc. It seems the fact of putting a maximum rate for private incandescent, which appeared in old arrangement, has been overlooked in the new, and the Royal's incandescent rate at present is ¾ cent per lamp hour on 50 volt basis, less 33⅓% cash discount for prompt payment. The Lachine Company are on the same basis except that their discount is 40%. The old rate was ¾ c. net.

Mr. Walbank, the able and energetic managing-director for the Lachine Rapids Company, is to be congratulated on again securing the arc lighting contract for the municipality of Westmount. The figure named is $90.00 per arc per annum. This is slightly better than the former price to the municipality, which was $100.

Mr. Tabener, one of the most esteemed contract canvassers, formerly with the Royal Electric Company, has severed his connection with that company, and accepted a like position with the Lachine Company. His friends will wish him success in his new position.

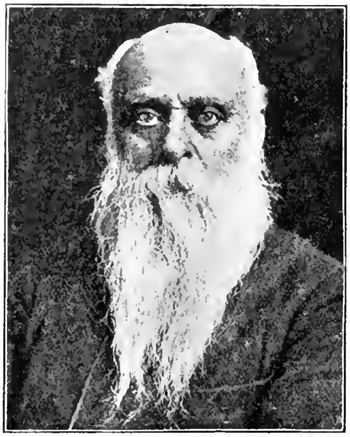
The Standard Light & Power Company, which is is to a certain extent affiliated with the Lachine Company, has just declared a dividend at the rate of 8 per cent. per annum. This company is managed by Mr. Chas Morton, and appears to move in the even tenor of its way, doing a snug and profitable little business and keeping free from fracas with civic officials and costumers. They purchase their "juice" wholesale, as it were, from Lachine Company and transform it by motors and dynamos from A. C. to D. C., serving principally motors; although they do considerable lighting also. A steam reserve plant is kept as a stand bye.

The Imperial Electrical Company in the north-eastern part of the city, have transferred their allegiance (or are about to do so) to the Royal Electric Company. This company do considerable lighting business in that portion of the city, and have a numerous clientele of retail stores on St. Lawrence Main street.

## MR. JOHN HORN.

It is with peculiar satisfaction that we reproduce herewith the portrait of Mr. John Horn, a well-known telegrapher of the early days. Mr. Horn was the editor of the first Canadian electrical journal. It was published in Montreal by Hart Bros. & Company, in the year 1884, and bore the same title as this journal, the publication of which was commenced some years after the pioneer electrical journal had ceased publication.

Born in Montreal in 1837, Mr. Horn at sixteen years of age found employment with the Montreal Telegraph Company, and in 1857 removed to New York, where he became identified with the American Telegraph Company. Afterwards he entered the service of the Western Union Telegraph Company and for a time was manager of the stock exchange business of that company.



MR. JOHN HORN.

Returning to Canada he engaged in the Canadian Military Telegraph Service in the North-West. In late years Mr. Horn has been a resident of Montreal. He is the possessor of a fine collection of early American and Canadian history of the telegraph and of many relics relating to the early days of the discovery. Mr. Horn still takes an active interest in everything pertaining to the application of electricity and was a prominent figure at the recent convention in Montreal of the Old-Time Telegraphers' Association.

## ELECTRICAL DEVELOPMENT IN TORONTO.

The rapid growth of business in the supply of current for both light and power has compelled the Toronto Electric Light Company to install another new engine of 1,500 horse power, built by the Polson Company of Toronto. This engine, which is of the vertical type, has unusually heavy parts and is most substantially built throughout. The fly-wheel weighs 40 tons, the total weight of the engine being in the neighborhood of 200 tons. The cylinders are 56 inches in diameter. The bearings throughout are water-jacketted, thus insuring coolness in operation. This new engine is called the "Duke of York" and was put in operation on Thursday last on the occasion of the Duke's visit to Toronto.

The Toronto Electric Light Company have now a total engine capacity of 7,000 horse power, and owing to the rapid growth of their business will be compelled to install additional engines at an early date. About two-thirds of the engine capacity is in constant operation, one-third being always kept in reserve. On the occasion, however, of the Royal visit more than the total capacity was required to supply current for street illumination.

## THE USE OF FRICTION CLUTCHES.

The Dodge Manufacturing Company, Toronto, have drawn our attention to a paper on friction clutches read before the New England Manufacturers' Association by Mr. R. Hill, of which the following is an abstract:

To construct a good efficient friction clutch of any class requires a great deal of patience of the cut and try order until the parts are so constructed and balanced that the clutch will back up the principle involved and when put on the market it will not be a source of annoyance on account of the weakness of some apparently unimportant part. I would advise that when you get your clutch, be sure it is fitted by a careful and exact machinist who is well acquainted with the clutch in hand. Provide solid, substantial foundations, and in the case of large friction cut-off clutches use a connecting bed plate for the bearings on each side of it, and when it is erected, be sure the shafts are in perfect alignment and that they will be held there.

The growth of the friction clutch industry has, like many other good things, been phenomenal. It is my firm belief that there has been manufactured and put upon the market a larger value and greater number of friction clutches in a single day in the year 1900 than was produced in the whole year of 1875. The general introduction and use of electricity has been largely responsible for the increased demand for first-class friction clutches. The high speeds at which they are invariably run in electrical generating plants, and the extremely severe duty required of them for this class of work, has brought out the best efforts of our mechanics in producing satisfactory running clutches. It has been one of the best advertising mediums of the friction clutch business, and has, in many instances, shown to enquiring minds the advantage of the adoption of friction clutches in other channels of work.

It is an accepted fact that no first-class builder of machine tools, or of any other machines that need to be stopped and started frequently, does not find it to his advantage, as well as to his customer's, to use friction clutches to operate the said tools or machinery. Compare the ordinary engine lathe, built on modern lines, having a good friction clutch pulley countershaft, with that old annoying arrangement having a jaw-clutch pulley countershaft. The slam-bang noise of one of these pests when in use in a shop is enough to put the men's nerves on edge, to say nothing of the hard labor and skill necessary to operate it and the liability of spoiling the work in hand.

Go a step further and compare the modern friction clutch pulley countershaft with the old tight and loose pulley affair with its shifting, sluggish, squealing belt, which is continually wearing out and breaking down. Note the ease with which the operator controls the machine having the friction clutch device. He can do more work, better work, with less exertion and less wear and tear on the machine and belts. Yet it is not such a long time since the manufacturer, and even the operator, thought the old jaw-clutch or tight and loose pulley device on a lathe was pretty good. The fact is, they did not know of anything better. It is human nature to judge by comparisons, and the enlightenment in the use of friction clutch devices, their advantages on a lathe counter or any other machine, is the reason of the ever-increasing demand for the many thousands of friction clutches manufactured annually and the enormous increase in the number of willing buyers.

## SPARKS.

The village council of Hintonburg is considering municipal ownership of electric lighting. It is estimated that, with the boiler and other appliances which may be utilized, a plant could be installed for $4,000.

The Canadian Niagara Power Company have taken tenders for placing cofferdam in the Niagara river and for laying an underground conduit to the extent of 36 ducts for one mile. The work is in charge of Mr. Cecil B. Smith, Ma. E.

John Blackburn, an electrician, died in the General Hospital in Toronto last month, from injuries received in a fall from a telegraph pole in Wheeling, West Virginia. The fall was caused by his arm coming in contact with a live wire.

M. N. Patrick, Industrial Agent Seaboard Air Line Railway at Pinebluff, N.C., the well known winter health resort, offers building and power free to parties wishing to start manufacturing in a small way with view of enlarging. No doubt many will accept this generous offer.

CANADIAN

# ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

Vol. XI. NOVEMBER, 1901 No 11.

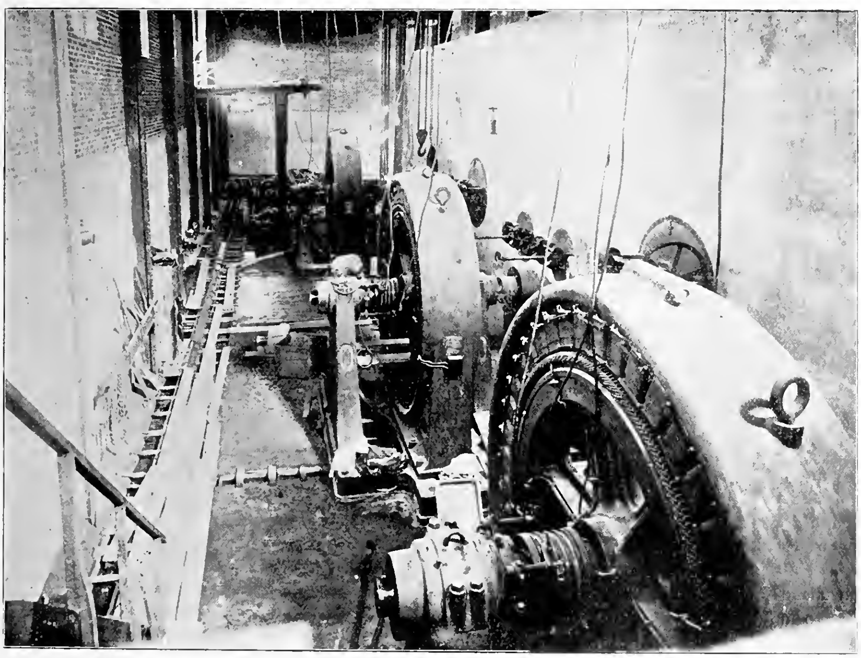
## NEW DISTRIBUTING STATION.

The new station of the Ottawa Electric Company, which has been under construction since shortly after the great fire of April 26th, 1900, was opened on Thursday, 24th ultimo. The water was let into the flumes at 9.30 in the morning, and at 9.54 one set of wheels and the first generator were started. The station is almost complete, there remaining only the switchboards and cables to install. The experiment was exceedingly satisfactory to all parties concerned, the concrete walls proving to hold water exceedingly well, there being practically no leakage anywhere. The whole work is of the most satisfactory character. Nothing enters into the construction of the flumes and buildings but iron, steel, stone, brick and concrete. They are absolutely fireproof, even the window frames and sashes being of metal.

The equipment consists of three 700 K-W., 2200 volts, two-phase generators, manufactured by the Westinghouse Company, and adapted to run at 180 r. p. m., giving 7,200 alternations per minute. These are directly connected each to three 39″ wheels attached to one shaft and governed by Lombard water wheel governors. The wheels were manufactured by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio.

For the accommodation of the patrons of the company who already have D. C. motors, a rotary transformer and storage battery supply D. C. power.

The arc light plant consists of six Western Electric Company 150 light generators direct connected in pairs to three 250 h. p. Westinghouse induction motors. These supply current to Adams-Bagnall series D. C. enclosed arc lamps. There are two exciters direct connected, each capable of exciting all the generators in the station. These run at 475 r. p. m, and each is driven by a pair of 15-inch wheels. Provision has been made for the possible clogging of these wheels with frazil, by attaching driving pulleys to the shafts of the main wheels, to which the exciters may be belted while disconnected from the water wheels.

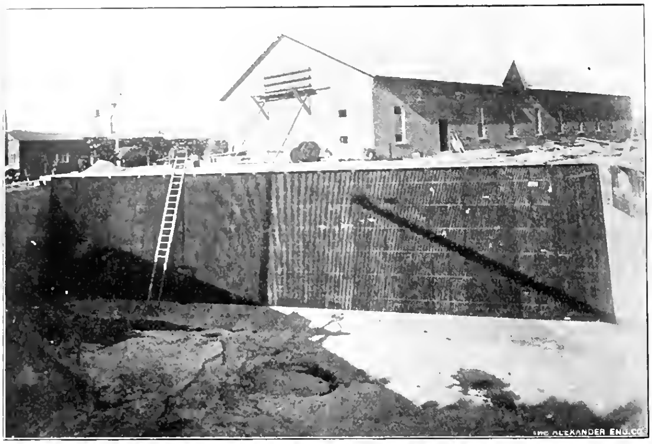


Distributing Station Ottawa Electric Company—View of Dynamo Room From West End.

The switchboards will be very complete and modern in character, special attention having been given to this part of the work so as to ensure easy operation of the station. All connections will be made through

lead covered cables laid in troughs in the floor. A travelling crane of 20 tons capacity will make the handling of machinery in this station an easy matter. Space has been provided for an additional unit of 700 K.W. in water wheels and generator whenever it may be desired to install it.

This building will be the main or distributing station of the company. The other two stations which were saved from the fire, one a water power station and the other a steam station, will, after being somewhat remodelled and modernized, be used as auxiliaries and reserve stations, current generated in these being transmitted to the distributing switchboards in the main station.



Distributing Station, Ottawa Electric Company—View from the West, Showing Ponds and Racks.

## MOND FUEL GAS.*

The possibility of using cheap fuel and of recovering its ammonia has been the subject of Dr. Mond's experimental work on gas producers, which was started in 1879 and has been carried out on a large scale for a number of years at Winnington, Cheshire, England. This work resulted in the solution of the difficult problem of converting the cheap forms of fuel into a good gas of uniform quality in such a way that the ammonia existing in the fuel is not destroyed, but recovered as a by-product. Common bituminous slack, brought by railway wagons into the works, is mechanically handled by elevators and creepers and deposited in hoppers above the producers. From these, it is fed in charges of 8 to 10 cwts. at a time into the producer "bell," where the first heating of the slack takes place, and the products of distillation pass downward into the hot zone of fuel before joining the bulk of the gas leaving the producer. The hot zone destroys the tar and converts it into a fixed gas, and also prepares the slack for its descent into the body of the producer, where itis acted upon by an air blast, which has been saturated with steam at 85° C. (185° F.), and superheated before coming into contact with the fuel. Unlike what is done in other producers, the quantity of steam introduced into the blast is relatively large, and amounts to 1½ tons for every ton of fuel gasified. This large quantity of steam keeps down the working temperature of the producer within such limits as to prevent the formation of clinkers or the destruction of the ammonia, yet permits the fuel to be so thoroughly burned that good ashes are obtained. Half a ton of steam is decomposed in the producer for every ton of fuel burned, yielding thereby free hydrogen to the extent of 29 per cent. by volume in the final gas. The hot gas and undecomposed steam leaving the producer pass first through a tubular regenerator in the opposite direction to the incoming blast. An exchange of heat takes place, and the blast is still further heated by passing down the annular space between the two shells of the producer on its way to the fire grate; then the hot products from the producer are further passed through a "washer," which is a large, rectangular, wrought-iron chamber with side lutes; and here they meet a water spray thrown up by revolving dashers, which have blades skimming up the surface of the water contained in the washer. The intimate contact thus secured causes the steam and gas to be cooled down to about 90° C. (194° F.), and by the formation of more steam, tending to saturate the gas with water vapor at this temperature, the bulk of the sensible heat is converted into latent; then passing upward through a lead-lined tower, filled with tile to present a large surface, the producer gas meets a downward flow of acid liquor, circulated by pumps, containing sulphate of ammonia with about 4 per cent. excess of free sulphuric acid.

Distributing Station, Ottawa Electric Company—Interior of Main Flume, Showing Racks in the Distance.

*A paper read by Mr. H. A. Humphrey, M. I. M. E., at the Institute of Mechanical Engineers, London.

Combination of the ammonia of the gas with the free acid takes place, giving still more sulphate of ammonia, so that to make the process continuous, some sulphate liquor is constantly withdrawn from circulation and evaporated to yield solid sulphate of ammonia, and some free acid is constantly added to the

DISTRIBUTING STATION, OTTAWA ELECTRIC COMPANY—VIEW OF DYNAMO ROOM FROM EAST END.

liquor circulating through the tower. The gas, being now freed of its ammonia, is conducted into a gas-cooling tower, where it meets a downward flow of cold water, thus further cooling and cleaning it before it passes to the various furnaces and gas engines in which it is used. The cooling of the gas with its burden of steam results in the condensation of the steam and in raising the temperature of the cooling water, so that the latter leaves the bottom of the tower as hot water, which is utilized in a third tower, called the "air-heating tower," through which the air blast from the blower is directed. Here, the contact of hot water and cold air gives cold water and hot air, saturated with water vapor at 73 C. (163 F.). By this method of utilizing the heat of the gas from the producer, nearly 1 ton of steam is added to the producer blast for every ton of fuel gasified; and this cyclical exchange of heat is always going on, and forms one of the distinctive features in the economy of the process. The hot water from the gas-cooling tower is circulated through the air-heating tower, and being thereby cooled is again pumped up to the top of the gas-cooling tower. Both towers are filled with tiles, to give large surfaces of contact, and the circulating water acts as the heat-carrying agent between the hot gas and the cold air. The charging of the fresh fuel into the top of the producer and the withdrawing of ashes from the bottom in no way interfere with the continuous steady work of the producer. Also, the large volume of steam employed acts as a most perfect regulator in keeping the quantity of gas uniform. Each Mond producer of the ordinary size used at Winnington is capable of gasifying 20 to 24 tons of slack per day of twenty-four hours, and the volume of gas furnished from 1 ton of fuel fed into the producer varies from 140,000 to 160,000 cubic feet, according to the quality of the slack, and is sufficient to develop 2,000 indicated horsepower hours when utilized in a gas engine. The value of the sulphate of ammonia recovered from 1 ton of fuel is, at present prices, 8s. ($1.94), naked at the works.

## MR. HAROLD W. BUCK.

Mr. Harold W. Buck, whose portrait is here presented, holds the position of electrical engineer of the Niagara Falls Power Company and its allied corporations. He is one of the youngest men in the electrical profession to have attained a position of such importance. He is made the subject of a sketch by the Electrical World and Engineer, from which we learn that he is now in his 28th year.

Mr. Buck graduated from Yale University in 1894, and afterward took a post-graduate course at the Columbia School of Mines, receiving the degree of E. E. in 1895. For some years he was employed by the General Electric Company at Schenectady, where he displayed an unusul degree of originality and inventive genius. He devised a three-phase motor operating by static induction and took out several patents for electrical and mechanical devices. With two associates Mr. Buck devised and patented a process for making corundum in an electrical furnace. This process is now being applied in a plant at Niagara Falls which will manufacture 5,000 tons a year of the finest corundum. During the latter part of his engagement with the General Electric Company he acted as one of the assistants to the engineer of the lighting department.

MR. HAROLD W. BUCK.

In September of last year Mr. Buck was appointed electrical engineer of the Niagara Falls Power Company, the Cataract Power & Conduit Company, of Buffalo, the Tonawanda Power Company, and the Canadian Niagara Power Company. He will direct the selection and arrangement of the electrical equipment for the large development of the Canadian Niagara Power Company which has just been commenced on the Canadian side.

CANADIAN ELECTRICAL NEWS AND ENGINEERING JOURNAL

PUBLISHED ON THE TENTH OF EVERY MONTH BY

THE C. H. MORTIMER PUBLISHING CO'Y of Toronto, Limited,

HEAD OFFICE: CONFEDERATION LIFE BUILDING,
Corner Yonge and Richmond Streets,
TORONTO, - - CANADA.
Telephone Main 2362.
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### *EDITOR'S ANNOUNCEMENTS.*

Correspondence is invited upon all topics coming legitimately within the scope of this journal.

**The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.**

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**One Question.** We wish every reader of the ELECTRICAL NEWS to submit one question this month for our Questions and Answers Department. Think out a point on which you desire enlightment—whether pertaining to the boiler room, the dynamo room, line construction, or to methods of management. An effort will be made to give an intelligible and helpful reply.

**Crude Oil as Fuel** We have been asked regarding the extent to which crude oil is used as fuel for heat purposes. As far as can be learned oil is not employed at all for this purpose in the east, as it cannot compete with bituminous coal. On the Pacific coast, where conditions are more favorable, it is used quite extensively. One pound of oil will evaporate about twice as much water as a pound of coal, so that where oil is more than twice the price of coal per unit of weight it is preferable, as it is more cleanly to handle and permits more work to be gotten out of a given installation of boilers.

**Electric Lighting Statistics.** A report recently issued by the Department of Labor at Washington affords conclusive evidence of the almost universal use of electricity for public lighting in the large cities of the United States, and also that with few exceptions the light is supplied under contract by private companies. Out of 135 cities, only one (not reported) is without an arc lighting system. The younger and progressive cities especially show preference for electric light, 43 of such cities being entirely dependent on arc lighting. While public ownership of water-works systems is found to be the rule, only 11 out 135 cities own and operate their own lighting plant, and some of these such as Springfield, Ill., lease it to a private company.

**Liquid Air.** A year or two ago the public were startled by an article in one of the leading American magazines which clnimed that a process had been discovered for manufacturing liquid air in unlimited quantities and at a very moderate cost. It was further claimed that means had been found of applying liquid air to the generation of power—that in short, liquid air was a kind of perpetual motion machine, by means of which power could be generated continuously at little or no cost. The statements contained in this article were scouted by persons competent to judge of their value, but as usual many of the readers of the article who had not the knowledge requisite to enable them to judge of the practicability of the claims made were induced to invest their money for the promotion of the new (?) discovery. Very little has since been heard about liquid air, but it is now learned that the company which was formed to promote the so-called discovery has become bankrupt.

**The Assessment of Electrical Companies.** In connection with the appeals of the Toronto Street Railway Company, the Toronto Electric Light Company, and the Bell Telephone Company against the assessmenrs imposed on their properties by the city of Toronto, the Courts have decided in favor of the companies. In imposing heavy assessments on these companies, the city interpreted certain legislation passed

by the Ontario Legislature at its last session to mean that what has come to be known as the "Scrap Iron Assessment" decision by the Courts was no longer in effect. The Courts have decided in the present case, however, that this decision is in no way affected by the legislation referred to, and on this ground the appeals of the companies have been allowed. The newspapers are consequently in a rage, and are repeating many of the absurd statements regarding the companies which appeared when the Conmee Act was before the Legislature. The fact that a number of men bind themselves together in a business enterprise instead of investing their money separately appears to be sufficient to make them the mark for attack on the part of the newspapers, while strange to say the man who invests his money in an individual enterprise is spoken of in the light of a public benefactor. Just where the difference comes in is hard to determine. So far as can be learned there is no desire on the part of the electrical companies to escape their fair share of taxation, as is proved by the case of the Toronto Electric Light Company, one of the appellants in the case which has just been decided. The amount paid in taxes by this Company on their machinery and plant has been in proportion to their receipts, while in addition they have been taxed in the usual way on their buildings and land. This company may be taken as a fair example, being a well managed concern. If any change is thought to be necessary in the method of assessing electrical companies, the most equitable plan would seem to be the one suggested to the Legislature last year, namely, that the assessment on machinery and plant should be based on the total receipts of the business, while the buildings and land should be assessed separately in the usual way. This method would be likely to give satisfaction to all parties concerned. There would be no difficulty in ascertaining the amount of the total receipts of each company, as the figures are made out yearly for the shareholders and in the case of the larger companies are distributed in printed form.

**High Speed Electric Traction.**

At the International Engineering Congress held in Glasgow on September 4th last, a paper was presented by Mr. O. Lasche, giving particulars of some of the experiments which have recently been made near Berlin to demonstrate to what extent a very high rate of speed is practicable on railways with electricity as the motive power. The experiments in their first stage related only to the construction and testing of the car, which had been specially designed for high speed service. This car is about 22 meters in length, and in cross section conforms to the standard German state railway carriages. It will accommodate about 50 passengers. All parts carrying current are contained in closed compartments to prevent the possibility of injury to passengers. The motors, which are 3-phase 250 h. p. with a maximum capacity of 750 h. p. are directly attached to the car, no locomotive being employed. The car body is carried by two bogies, or trucks, each with three axles, of which the center is only a running axle. The sole effect of the designer was to construct a car capable of running long distances at the highest possible speed. The weight, which for an output of 8,000 h. p. was originally 50 tons, was subsequently reduced to 30 tons by modifications in the apparatus. A liquid starting device that could be equally well used for large winding engines was designed. The author of the paper states that from the results obtained in the preliminary trials, there is every reason to hope that the motor car will meet all requirements, and enable the association to deal with the questions relating to the running of the car on the track. In the following discussion Sir Wm. Preece warmly commended the candor with which the methods employed in the experiments had been described. He also strongly advocated the three-phase system, and said that three-phase was really more continuous than a continuous current, i. e., if the energy curve of a three-phase set of waves be plotted, it would be found to be a straight line. In further comparing the two systems, he said that the three-phase saves 30 per cent. in weight of machinery, and by using 3,000 volts pressure on the line the cost of conductors is greatly diminished, and 40 per cent. at least saved in capital expenditure. A representative of the association which is conducting the experiments remarked that owing to the railway monopolies and the absence of railway competition in Germany, it would not be surprising if Great Britain, which was the pioneer user of the steam locomotive should also be the first to use high speed electric railways of great length. It is to be hoped that in due time we shall learn of the successful completion of these important experiments involving another great step forward in electrical development.

## ACETYLENE GAS EXPLOSION.

The firm of Shaw & McKerracher, of Perth, Ont., have been using acetylene gas for lighting purposes. A short time ago while Mr. Shaw was wiping around the machine, a small quantity of gas which had not been drawn off ignited, and severely burned his hands and face. Last month a more serious explosion took place. According to the Perth Expositor, Mr. Ditrick, the agent for the machine in Perth, and Mr. Richard Walker were about to make some repairs to the machine. Feeling satisfied that all the gas was out of the machine, Mr. Ditrick disconnected the piping. As the machine was turned over the small quantity of water remaining in the tank below the fawcet ran to the lowest edge of the tank and the gas still remaining was forced out. A lamp was procured, whereupon the gas ignited, causing an explosion. One part of the machine was hurled forward with considerable violence, breaking down the partition, and the burning gas struck Mr. Walker in the face and on his arms. He was badly burned, and it is feared that his eyesight may be injured. Mr. Ditrick was less seriously injured, although he has since been confined to his house. The explosion was heard several blocks away. It is said that Shaw & McKerracher have decided to discontinue the use of acetylene gas.

The ratepayers of Grimsby, Ont., have voted down a proposition to buy the electric light plant of J. W. Van Dyke.

The suit in which the Ottawa Electric Company, Hull Electric Company and corporation of Hull are interested, concerning the monopoly of street and domestic lighting within the limits o Hull, will shortly be heard by the Privy Council of England.

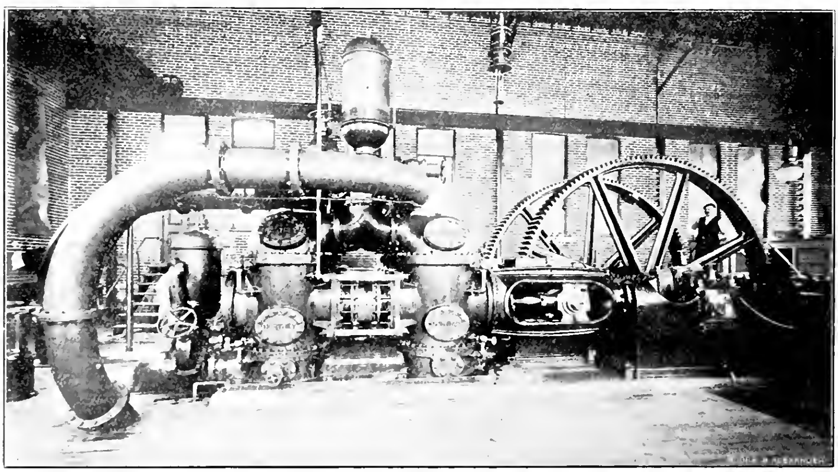
Ald. J. S. Askwith is about to commence the improvements to the water power of the Capital Power Company at Deschenes, Que. The work will consist chiefly in cutting a large channel about 200 feet long to a depth of 7 feet beneath the surface of the water. It is hoped by this means to add about 3,000 horse power to the present capacity.

## ELECTRICALLY DRIVEN POWER PUMPS.

The most important electrically driven power pumps yet installed in Canada are those for the Monrteal Water and Power Company, manufactured by the Northey Company, Limited, Toronto. They consist of two horizontal triplex pumps, one at the St. Gabriel Station, erected in 1899, and one at the Clarke Avenue Station, erected this year. The pumps are similar in design, so that a general description of the first machine will serve for both.

The pump at St. Gabriel has three double-acting outside-centre packed plungers 21 inches diameter by 24 inches stroke, made of hard, close-grained iron, working in deep phosphor bronze bushings, which form the neck bushes of the packing boxes. The packing box glands are also lined with bronze, and are fitted with supplementary packing glands to take up any drip which may pass the main packing. The pump rods are of solid tobin bronze, a taper fit in plungers and crossheads, securely attached to the former by bronze lock nuts, and to the latter by steel cotters. The crossheads are heavy steel castings fitted with adjustable shoes of bronze. The guides are cylindrical in shape, with large openings in each side to give access to crossheads and glands of pump rods; they are turned and faced at each end to fit the pump cylinders and main frames respectively, and bored out to receive the crosshead shoes, so that each pump is in accurate alignment with its guide. The construction of the water end is as follows: The front and back end of each pump is formed by two cylinders intersecting each other, and is cast in one piece with the suction and discharge decks, which are massive flat plates heavily ribbed on under side between each valve seat, access being had to the valves through ample hand holes in pump body and in the force chambers on top.

The pump valves are of medium hard rubber 4 inches diameter, and the springs are of phosphor bronze, a brass plate being interposed between spring and rubber with a grooved recess to keep spring in place. The valves in each deck are 36 in number, giving a valve area of 60 per cent. of plunger area; so that the mean velocity of water through the valve openings is about 135 feet per minute for a plunger speed of 80 feet. The two portions of each pump are rigidly tied together by four steel rods 3 inches diameter. The bottom flanges are faced off and bolted to suction base, one base receiving the two ends of each pump; and the top flanges are faced to receive the force chambers. As the suction deck is part of the pump cylinder casting, the joints at suction base are not subject to pressure. Each suction base is provided with a relief valve, set to open at 20 pounds per square inch, in order to provide against any possible accumulation of pressure between suction deck and foot valve when pump is at rest. The force chambers are semi-spherical in form, with ample discharge openings near the top. Each pump is provided with large air chamber, with automatic air charging device attached to each. Gate valves are placed in suction and discharge connections to each pump, so that any one pump, or any two pumps may be used, and the other disconnected. The discharge pipe from each pump is also provided with a 6 inch spring-loaded relief valve, which is used in starting the pumps, as well as to relieve an excessive pressure automatically.



ELECTRICALLY DRIVEN POWER PUMP BUILT FOR THE MONTREAL WATER AND POWER COMPANY.

The suction in entering makes a complete circuit of the three pumps, a run-around pipe or loop being placed at the opposite end of suction bases to that by which the main suction enters. The suction pipe to each pump is 16 inches diameter, being joined by easy angles to the common suction pipe, which is 24 inches diameter. A large vacuum chamber is placed immediately over the vertical pipe, through which the suction is led to the pumps. The discharge connections from each pump are 14 inches diameter, uniting by easy angles and bends into a common discharge of 20 inches diameter.

The pump has a rated capacity of 5,000,000 Imperial gallons in 24 hours, when making 20 revolutions or 80 feet plunger speed per minute, and is connected by a friction clutch to a 450 h.p. synchronous motor of the S.K.C. type, made by the Royal Electric Company, of Montreal. This motor runs at 180 revolutions per minute on 66 cycles at 2,400 volts.

The gearing is single reductions about 9 to 1, one

pair of gears on each side of central pump. The large gears have 160 teeth, and pinions 18 teeth, pitch 3½ inches. The crank shaft is a solid steel forging, 10 inches diameter in journals and crank pins, two journals and centre crank to each pump. The main bearings are four part boxes of tough bronze lined with best quality of babbit metal, and fitted with wedge adjustment back and front. The connecting rods are also fitted with bronze boxes lined with hard babbit, and have wedge adjustment.

This pump was built for a working pressure of 110 lbs. per square inch, but by reason of the exigencies of the service was worked for over a year against a pressure of 130 to 135 lbs. Very careful tests of the pump have been made by the engineers of the Montreal Water & Power Company to determine its efficiency. The first test was made when working against a pressure of 110 lbs. A standard Weston watt-meter was used to obtain the true watts, and Crosby indicators to determine the horse power delivered at discharge deck of pumps. The test showed an efficiency of 85 per cent., that is, the horse power compared from the indicator cards was 85 per cent. of the electrical horse power at the motor. The voltage during this test was 2,240 volts.

A second test was made after a booster had been placed in the circuit to raise the voltage to 2,400, the pressure on the pump being increased at the same time to 140 pounds. On this occasion the horse power, computed from the cards, was 376, while the wattmeter showed the electrical input at 430, thus giving an efficiency of 87.4 per cent. from the switch-board to the discharge deck of the pump. The same efficiency was also obtained when the pressure was reduced to 127½ pounds.

The pump at the Clarke Avenue Station is similar to that just described, but the plungers are 19½ inches diameter, 24 inches stroke, and the pump built for a working pressure of 175 pounds per square inch. The proportions are somewhat heavier on account of the greater pressure pumped against.

Much credit is due the Northey Company for the mechanical construction and successful operation of the pumps.

## TESTS OF A STEAM TURBINE.

Some recent tests of a 300 horse power DeLaval turbine, directly connected to a Ganz dynamo, were reported in August. Since then, says the Engineering Record, some interesting figures of the performance of a turbine driven centrifugal pump operating under a head of 588 feet have been received. The pumping unit was a steam turbine fire engine, of 50 effective horse power, run at a speed of 20,000 revolutions per minute. It consisted of a high pressure centrifugal pump coupled directly to the turbine shaft and of a low pressure centrifugal pump mounted on the secondary shaft, which is connected by a 10 to 1 reducing gear. The low pressure suction was 4.92 inches in diameter and the pump delivered to the high-pressure pump which discharged through a 3.94 inch pipe. The head in the test was varied by a throttle valve. The results are as follows, steam, about 117 pounds pressure :

| | | | | | |
|---|---|---|---|---|---|
| Total head, ft....... | 165.6 | 279 | 326 | 489 | 588 |
| Gals. of water per sec. | 7.28 | 7.09 | 6.73 | 5.07 | 3.4 |
| H-P in water pumped | 18.6 | 30. | 33.8 | 38.2 | 30.7 |
| Steam per water H-P per hour pounds... | 96.8 | 67.2 | 61.6 | 57.3 | 67. |

## RETIREMENT OF MR. W. H. BROWNE.

A dispatch from Montreal dated October 26th states that Mr. William H. Browne, General Manager of the Royal Electric Company, has tendered his resignation, to take effect three months hence. Mr. Browne assumed the position which he now occupies in 1893, having previously been manager of the United Electric Light & Power Compan, yand held other important positions in the United States. He was connected with the early development of the electric railway, and previous to coming to Montreal had gained wide and valuable experience in connectiou with the adaptation ot electricity for light and power. This experience, coupled with unusual executive ability, has enabled him to do valuable work in his present capacity. When he took charge of the Royal Electric Compauy in 1893 its affairs were not in a promising condition. During Mr. Browne's regime the company's stock has constantly advanced in price as the result of his careful yet progressive management.

While residing in Montreal Mr. Browne has taken a most active interest in all matters affecting the welfare of that city. He has also been a valuable adjunct to the Canadian Electrical Association, of which he was elected President three years ago. For some time past Mr. Browne has not enjoyed good health, and it may be that to this cause is due his decision to relinquish the heavy responsibilities which have rested upon him for so many years and which he has so successfully discharged. We have not learned what his intentions are for the future, but trust that he may still remain in Canada, where he has so many friends and admirers.

## MOONLIGHT SCHEDULE FOR DECEMBER.

| Day of Month. | Light. | | Extinguish. | | No. of. Hours |
|---|---|---|---|---|---|
| | | H.M. | | H.M. | H.M. |
| 1.... | " | 5.00 | P.M. | 0.30 | 7.30 |
| 2 ... | " | 5.00 | " | 1.30 | 8.30 |
| 3.... | " | 5.00 | " | 2.30 | 9.30 |
| 4.... | " | 5.00 | " | 3.30 | 10.30 |
| 5.... | " | 5.00 | " | 4.30 | 11.30 |
| 6.... | " | 5.00 | " | 5.30 | 12.30 |
| 7.... | " | 5.00 | " | 6.15 | 13.15 |
| 8. .. | " | 5.00 | " | 6.30 | 13.30 |
| 9.... | " | 5.00 | " | 6.30 | 13.30 |
| 10.... | " | 5.00 | " | 6.30 | 13.30 |
| 11.... | " | 5.00 | " | 6.30 | 13.30 |
| 12.... | " | 5.00 | " | 6.30 | 13.30 |
| 13.... | " | 5.00 | " | 6.30 | 13.30 |
| 14.... | " | 5.00 | " | 6.30 | 13.30 |
| 15.... | " | 5.00 | " | 6.40 | 13.40 |
| 16.... | " | 8.45 | " | 6.40 | 9.55 |
| 17 ... | " | 9.45 | " | 6.40 | 8.55 |
| 18.... | " | 10.50 | " | 6.40 | 7.50 |
| 20.... | " | 0.00 | " | 6.40 | 6.40 |
| 21.... | A.M. | 1.10 | " | 6.40 | 5.30 |
| 22.... | " | 2.20 | " | 6.40 | 4.20 |
| 23.... | " | 3.30 | " | 6.40 | 3.10 |
| 24.... | " | 4.40 | " | 6.40 | 2.00 |
| 25.... | No Light. | | No Light. | | .... |
| 26.... | " | | " | | .... |
| 27.... | " | | " | | .... |
| 28.... | P.M. | 5.10 | A.M. | 10.10 | 5.00 |
| 29.... | " | 5.10 | " | 11.10 | 6.00 |
| 30.... | " | 5.10 | " | 0.10 | 7.00 |
| 31.... | " | 5.10 | " | 1.10 | 8.00 |

Total............255.45

## LEGAL.

The Boston Gas Light Company and the Edison Electric light Company of Boston, have been declared jointly liable for damage caused by an explosion of gas in a Boston subway in March 1897. The explosion is supposed to have resulted from the contact of a spark from a defectively insulated underground electric conductor with an accumulation of gas in the subway. It is held that the explosion might have been avoided if a man had been appointed to ventilate the subway at intervals.

# QUESTIONS AND ANSWERS

"Enquirer:" I would be much obliged if you would answer in the "Questions and Answers" column of the next number of the ELECTRICAL NEWS the following question, viz: What number of watts per lamp are required to furnish or supply the requisite energy to produce the full lighting power of the arc electric lamps of 2000 candle power which has been used for street lighting for some years back? Also what number of watts per lamp are required to supply energy to the alternating current arc lamp of 2000 candle power to give the standard of light now required for city street lighting by lamps of 2000 candle power?

ANS.—The arc lamp which is usually rated at 2000 c. p. is the open arc direct current series lamp in use for so many years, taking 9.6 amperes at 45 to 50 volts, or an average of 450 watts each, but latterly as the matter has been investigated in connection with the growing use of the enclosed arc, it has been found that the practice of rating by candle power is not a satisfactory method, as it but paves the way for an endless series of disputes, due to there being so many ways of measuring the light emitted. In view of this, the method of rating by candle power is being dropped wherever practicable, the consumption of the lamps in watts being given instead. It is considered that a series alternating lamp taking 6.6 amperes, and a voltage varying with the frequency, whose watt consumption is about 425, gives the same general average illumination as the old open arc 9.6 amp. lamp, though the light from it measured at some angles will be greater, and again at others less, than that emitted by the latter.

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"Ambition" writes: Would you please describe the construction of an electric radiator or heater?

ANS.—Any and all substances carrying electric currents have their temperatures raised when the current is flowing, and thus give off heat to the medium surrounding them. In wiring for light or power the conductors are made of such a size that the drops are uniform and that the losses are as small as possible commensurate with the cost, which means that the heat given off by them is practically imperceptible, but in making a radiator, heat being the desired result, the conductor is made of such style, shape and material as will give the greatest amount of heat with the least expenditure of energy. The heat which in practice is obtainable from a given amount of energy is limited by the temperature which the conductor will stand before oxidizing, and in order to raise this temperature to the highest point, some manufacturers use wire whose composition is more or less a secret, being made from some of the rarer metals, mounting the spirrals in an non-combustible and insulating frame, usually of iron and porcelain; other wires are made almost entirely of iron and imbed it in sand or cement, which has the effect of keeping the air away and thus allowing the heat to be greater than if the conductor were in the open air, in which case it would burn at a much lower temperature. It is not practicable for any but those commercially engaged in their manufacture to make a heater which shall be reasonably efficient, but if efficiency does not appreciably affect the case, a very serviceable article can be made from ordinary galvanized iron wire, the necessary size and length, in the absence of any information as to size of room you desire to warm, being a matter of experiment. If for alternating current care should be taken to wind it as much as possible non-inductively, and to thoroughly secure all the parts, or else the humming will be very loud and disagreeable.

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"Subscriber" asks: 1. How would you connect a Reliance arc dynamo? Supposing the machine had all parts disconnected, where would the fixtures, such as voltmeter, ammeter and rheostat, if there be any, be connected?

2. What would be the best way to set the brushes if there were four in circumference?

3. Should there be lubrication used on the commutator of a dynamo?

ANS. 1. All the field coils are connected in series, these again going in series with the armature, the two leads left being connected through the ammeters to the lamp circuit. If there is a voltmeter provided it would be connected across the line, though it is an expensive instrument and not usually provided with arc machines, especially those manufactured at the date the Vaston machine was on the market. No rheostat is used with this machine; when put on arc generators it is generally connected in parallel with the fields.

2. In a multipolar machine with four brushes they would be set either ¼ of the circumference apart or else spaced with the same arc between them as between two poles, and either opposite or between the latter, depending on the way the winding is connected. If the machine has only two poles, the brush holders are usually moveable so as to alter the relative position of the two pairs of brushes as the load changes.

3. All the commutators require lubrication; those that have much sparking taking place on them will need more than those running without sparking. As a general rule the more sparking there is, and therefore the greater the heat of the commutator, the stiffer should your lubricant be, a heavy grease giving good results, whereas for the latter an oil will generally be found preferable. It is a good plan to have two or three sets of brushes, where they are of carbon, and boil them occasionally in paraffine. Copper brushes should be soaked once in a while in coal oil or benzine, to cut out the dirt which will cake in the ends and cause heating and sparking. Whatever lubricant is used, care should be taken to prevent its getting round the edge of the commutator and into the end micas, as it destroys the insulation and induces grounds, also it collects and holds dust whenever it is not wiped clean. Sandpaper should not be used unless the commutator has got rough; the longer it will keep a good surface without being polished the better, leave it alone for years even if it will stay that way.

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"B. W.," Montreal: How do you determine the number of incandescent lamps that can be run in series off the primary alternating lines?

ANS.—The number depends on the primary voltage of the circuit and the amperage and the candle power of the lamps, thus a 50 candle power lamp, taking say 3 watts per candle, will have a total consumption of 150 watts. If it is for a 5 ampere circuit it will therefore take 30 volts across its terminals, and a primary line

potential of 2,100 volts would evidently supply 70 such lamps. It should be noted that the greater the amperes the greater number of lamps which can be run, also that in this system of lighting, unless provided with a regulator, the number of lamps on the circuit is invariable; any decrease from the proper figure results in too much current and burnt out lamps, any increase gives not enough current and thus poor light. The rule given above can conveniently be put in the following equation : Number of lights =

$$\frac{\text{primary voltage x ampere.}}{\text{candle power x watts per candle}}$$

## BY THE WAY.

Capt. Thomas Bixby, under whom Samuel M. Clemens (Mark Twain) served as pilot and "engineer" on the old Mississippi River boat Swallow, has given the following description of the engine of the Swallow : "The swallow had the queerest sort of engine that was ever seen. The craft itself was a little shaky—it only plied between St. Louis and Cairo—being about thirty feet long, with a stern wheel, a place for freight and passengers, a pilot-house, and a place on what may be called the pilot-deck for the engine. That engine went aboard when it was needed, and only then. It burned no wood nor coal, but ate a powerful sight of grass. It was a large gray mule named Jerry, which worked a treadmill that propelled the boat. Sam Clemens—you know his name of Mark Twain came later—was chief engineer and pilot. He had a system of signals and they were ingenious. By pulling a cord he could raise a head of cabbage just out of the reach of the mule. The engine would start for it, and begin to walk after it, and the boat floated majestically on down the river or up, as the case might be. When Sam wanted to stop he would pull a rope attached to the feed box of the engine. Without intending to be personal, I will say that Jerry was one of the most intelligent animals I ever met. His voice was more on the order of a fog horn than a whistle—it was too mnch of a baritone for the latter. When Sam wanted to whistle for a landing he hit Jerry with a stick. If he wanted, in the profane language of the river pilot, to go ahead like the ——, he gave Jerry a touch of the whip."

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Under the heading "Book Reviewing by the Boiler Inspector," The Locomotive prints the following : "We have received from the publishers a copy of 'An Englishwoman's Love Letters,' with a request that we give it a review in The Locomotive. We have no regular love-letter editor on our staff, and we therefore turned it over, first, to our expert on riveted joints, who is reputed to have had some experience in such matters. He says that the writer of the letters is badly designed ; that she has a poor circulation, and a cracked head, and that a few bricks are loose in her setting ; and he swears he will take no responsibility for her, until she has been submitted to a hydrostatic test of at least a thousand pounds. His judgment has always been good on matters more directly in his line, but we were so sure that it was in error in this particular case that we took the book away from him and made a complete internal inspection of it ourselves. We quickly found that the language is so warm that our expert on combustion was the proper man to consult. He was on his vacation, however, and we didn't want to call him back to make a calorimeter test during this hot weather. Our chemist shook his head sadly when we offered the job to him, and the only available man left on our staff was the automobile editor, who takes the place of the horse editor, that we discharged when the horse went out of fashion. He says the author has wheels all right. He doesn't wish to condemn the book, though, for he says that while it isn't in his line, he should judge that it would be hot stuff in somebody else's line. With this sentiment we heartily agree. It is our custom, in reading a work of fiction, to pick out the one passage in the whole book that seems to be most pat. We think we have found it, in this book, on page 203, where the author of the letters says to her hubby, "Oh, how tired loving you now makes me!" To which we would fervently respond, "Amen!"

## NEW STORAGE BATTERY FOR McGILL.

Some additions and alterations have been recently made in the electrical equipment and arrangements of McGill University, Montreal. The most important acquisition is a 300-kilowatt power storage battery, the current from which will be used for light and experimental purposes when it it is not desirable to use the steam plant. The whole of the Macdonald building could be lighted up by its current, so that by charging it during the day, work could be carried on at night without having recourse to the steam plant. For charging the battery one of the 50-horse power steam dynamo units of the present plant has been remodelled. Much auxiliary apparatus, such as switch-boards and metering devices, have also been installed.

The Macdonald Physics Buildings has been completely rewired, so as to conform in every particular with the highest insurance requirements. All the overhead wires of the lighting plant of the Macdonald Buildings have been removed, and replaced by highly insulated lead-covered cables. By this means the appearance of that side of the campus has been greatly improved, and the danger of interruption of the current through snow or ice falling from the buildings has been entirely obviated.

## FXPERIMENTS WITH BOILER TUBES.

Certain experiments have been made on the Oudh and Rohilkhand Railway with lap-welded steel tubes with the following result :—Lap-welded steel tubes have been put into boilers of engines, B class 81, C class 107 and 118, D class 126 and 133. The first boiler done being No. 133, which started work with them in February, 1899. All these boilers have a working pressure of 120 lbs of steam only. One tube of engine No. 133 was drawn out in order to see its condition on 9th September, 1900, after it had been in use 19 months and run 70,541 miles, and found that it showed signs of pitting all over, and especially in one place, about 18 inches from smoke box end. These tubes have given no trouble at all as regards leaking and have proved satisfactory so far, but it may be stated that the water on the O. and R. line is good at the stations where these engines take it. The price at which these were issued to the Loco. Department was Rs. 3-4-0 each and the rate for brass tube at the time was Rs. 11-8-0.—Indian Engineering.

## JUDGMENT AFFECTING ASSESSMENT OF ELECTRICAL COMPANIES.

For the benefit of electrical companies we give below the full text of the judgment rendered in a Triune Court, Toronto, by Judges McDougall, McGibbon and McCrimmon, regarding the assessment of the poles, wires, cables, etc., of the Toronto Electric Light Company, Toronto Railway Company and Bell Telephone Company. The legal quotations and references have been omitted :

The principal point to be decided is as to whether the basis of the valuation adopted by the Assessment Department is a correct one in the light of this amendment to the Assessment Act, made at the last session of the Ontario Legislature .

" Real property belonging to or in the possession of any person or incorporated company, and extending over more than one ward in any city or town, or situate in any township, may be assessed together in any one of such wards at the option of the assessor, or the assessment of the property may be apportioned amongst two or more of such wards in such manner as he may deem convenient, and in either case the property shall be valued as a whole or as an integral part of the whole."

At the date of this enactment the Legislature had before it three cases in which the Court of Appeal for this province had discussed and laid down the basis of correct method of arriving at the value for assessment purposes of the different classes of property involved in the present appeals. These cases were determined under the various provisions of the Assessment Act as that act stood prior to the Amending Act of 1901. The first case was the Bell Telephone Company v. City of Hamilton. The Court of Appeal held in that case : (1) That the poles, wires, conduits and cables of the Telephone Company must be valued in distinct units as they happened to be located in the several wards of the city, the portion of the poles, wires, etc., in each ward by itself and not as a part of a going concern. (2) That these poles, wires, etc , must be valued at the price they would bring if sold as so much material to be removed or taken away by a purchaser. (3) If the material was not actually sold the assessment value would be the sum at which such material would be taken by a creditor in payment of a just debt from a solvent debtor

The court was unanimous upon the point that this class of property could not be valued as a whole or as an integral part of a whole, nor as it it were a going concern ; in other words, the value of the portion in each ward must be arrived at separately apart from the rest of the work.

The next case relating to this subject was the London Street Railway case, in which, also, the court held that the ward division must be followed and each portion of what was in fact a continuous system could only be assessed in separate units in each ward, and that the several parts could not be considered as part of a going concern operated in the several wards, and the Bell Telephone case was followed as to the basis of valuation for the various ward units.

The next case was the Queenston Heights bridge assessment. In that case, which did not involve the ward divisions, the Court of Appeal also adopted the same basis of valuation to determine the assessable value of the Canadian half of an international bridge, the whole bridge being the property of one company. The so-called "scrap valuation" was applied and the assessment value of the half of the bridge on Canadian soil was placed at the value of the material to a purchaser who would have to remove and take the same away.

The Legislature, therefore, was fully possessed of the conclusions of the highest courts of this province as to the inadequacy of the machinery for assessing this peculiar class of property under the existing law, which property had come into existence subsequent to the date of the enactment of section 28 of the Assessment Act.

The court had found considerable difficulty in applying to modern railways, gas and water companies and electric telegraph companies provisions which were amply sufficient for the much more simple state of assessable property in the days when the assessment laws were first introduced. It was extremely difficult to ascertain the true value of such property. If any injustice resulted from the decisions of the courts in dealing with these perplexing problems, the remedy rested with the Legislature. In 1901 an amendment of the Assessment Act is made, and the point to be determined in these appeals is as to the extent that the new law varies or qualifies the decisions I have referred to.

The first change clearly made is to abolish the ward divisions, in considering the value of these new classes of constructive real property, where the operation of such enterprises and the plant essential to their useful equipment extends territorially beyond the limits of one ward. As a corollary to this abolition of ward divisions the assessor is allowed to value the real property of the owners or possessors of such concerns as a whole in one ward, or he is at liberty to value it in more than one ward, but, in such latter case, each ward unit is to be valued as an integral part of the whole.

I interpret this to mean that, having ascertained the value as a whole, he can, it he wishes, apportion to each ward the proportionate part of the whole value which appertains to the property lying within its boundaries, but it must be at the same values. The Legislature has made proper the method suggested by a judge who said, "The correct method would be to value the concern as a whole and then apportion rateably to the wards or the municipality as much of the value as falls to that part of the concern territorially situate in each locality.

The next most important consideration will be : Has the Legislature established any new basis of valuation from that laid down in the decided cases ? Has the standard or test prescribed by section 28 of the Assessment Act been altered, namely, that the property, whether real or personal, is to be estimated at its "actual cash value, as it would be appraised in payment of a just debt from a solvent debtor ?"

The Court of Appeal has distinctly laid down that rails, poles, wires, etc., must be valued only as material to be removed or taken away by a purchaser without regard to any adventitious value it possesses to the possessor or owners only ; any special value due to franchise or income-producing qualities does not follow the property into the hands of the purchasers, and cannot be considered in valuing it for assessment purposes under section 28 of the Assessment Act.

This principle is equally applicable to the whole line of rails, poles and wires, etc., whether they are to be considered as a whole or as composed of separate parts lying in different municipal wards of a city but forming one continuous system. In Toronto, where there are six wards, six separate scrap heaps under the former law may now be treated, if the assessor wills, as one scrap heap of poles, rails, wires, etc., removed from their connection with the operating system of which they are constituent parts. They are not to be treated as parts of a going concern in good condition of repair, nor are they to be valued as the estimated or ascertained cost of reproduction less any reasonable allowance for wear and tear due to their having been in use for any definite period since their installation.

In very truth the only apparent change effected by the recent legislation is to permit a different method of municipal bookkeeping whereby, as to this special class of assessable property, the whole value may be attributed to one ward if the Assessment Department desire to so assess it, or if they do not so elect, they can distribute the total value amongst several wards in proper proportions.

Section 28 of the Assessment Act still applies to all assessments, and its force as applied to rails, poles, wires, etc., I am of opinion, must still continue to be interpreted according to the principles laid down by the Court of Appeal. So far as the method of estimating the assessment value of the classes of property involved in the present appeals is concerned I am of opinion that the amendment enacted at the last session has effected no change whatever.

The parties to the present appeals have informed the Board that they have agreed upon the value which should be determined that the assessment is still to be made upon the same principle as that laid down by the Court of Appeal before the enactment of the amendment above discussed.

I am of the opinion that the appeals should, therefore, be allowed, and the amounts of the several assessments be reduced to the figures agreed upon between the city and the appellants.

The Assessment Department have added to their assessment the value of the rolling stock or cars of the Toronto Railway Company, and the company contend that these articles are not assessable as realty. The Assessment Department has, doubtless, been led to include the Railway Company's rolling stock as realty owing to the recent decesion of the Court of Appeal in the case of the Bank of Montreal v. Kirkpatrick, when the court held that the rolling stock of an electric railway should be regarded as against an execution creditor as part of the corpus of an entire machine (electric plant), and, therefore, in the nature of a fixture, and passing with the land over which it runs.

The whole doctrine of constructive annexation to land of articles ordinarily treated as chattels, so as to constitute them realty, has, in modern times received an extended application.

"The rolling stock of an electric railway," says a judge in the case referred to, "really constitutes part of one great machine, confined to a particular locality, for which it is especially constructed and fitted, operated by means of a continuous current of electricity, generated in part of the fixed plant in the power-house and passing through the trolley pole of the car, which is fitted to the overhead wire, through the car to the unbroken line of rails back to the generator. Of the entire machine thus operated the important part—the rails and power-house—are unquestionably realty, and the rolling stock forms part of it in a much more intimate and connected manner than does the rolling stock of a steam railway. Detached from the rails, it is incapable of use ; and as regards its liability to be taken in execution, it may be properly regarded as part of the corpus of the entire machine, and, therefore, in the nature of a fixture, and passing with the land over which it runs.

This decision was made in reference to an interpleader issue between execution creditor and trustees and debenture holders. If the rolling stock was chattel property, the creditors (plaintiffs) would succeed, there being no duly registered chattel mortgage covering chattel property ; if the rolling stock, like the poles and wires, was to be considered realty, and to form part of the land, then the defendants were entitled to succeed.

In disposing of the interpleader issue nothing turned upon the language of the mortgage purporting to cover the land, franchises and rolling stock. If the rolling stock was chattel property, the instrument purporting to mortgage it did not comply with the Chattel Mortgage Act, and it was not registered as a chattel mortgage. The question to be determined then was, is the rolling stock of an electric railway company personal property or

realty? The court held it was realty, and was not seizable under an execution against goods.

It appears to me, for the purpose of disposing of the question of the right to assess the rolling stock or cars of an electric road as realty, I must look upon that question as settled by the Court of Appeal in the case above referred to. Unless I have failed to properly appreciate the force of that judgment, the question is not open to consideration or decision by an inferior court.

I am of opinion that the cars used by the Toronto Railway Company on their electric road are, along with the rails, poles and wires, liable to assessment as realty, and that the value must be ascertained in the same manner as the value of the rails, poles and wires themselves.

I have been given to understand that the parties can agree upon the amounts to be inserted in the assessment roll relating to this portion of the assessable property of the company and upon handing in to this Board these figures the same can be embodied in the order. The Toronto Railway Company's appeal upon this branch of the case will be dismissed.

## MONTREAL

Branch office of the CANADIAN ELECTRICAL NEWS, Imperial Building,

MONTREAL, NOVEMBER 5th, 1901

We are told in the lay press that the Toronto illuminations for the Duke and Duchess of York surpassed anything that had been seen in Canada. Montreal happens to be in Canada, and although, of course, she cannot hope to compete in greatness with Toronto, yet we have the feeling that this story about illuminations should be told to the marines.

The resignation of Mr. W. H. Browne, general manager of the Royal Electric Company, will come as a surprise to many and to the regret of not a few. Mr. Browne in private life is a hail fellow well met, and agreeable in the extreme, as those of the electrical fraternity, both members and non-members of the C.E.A., are well aware. His loss to the C.E.A., in which he took a prominent part, will be keenly felt.

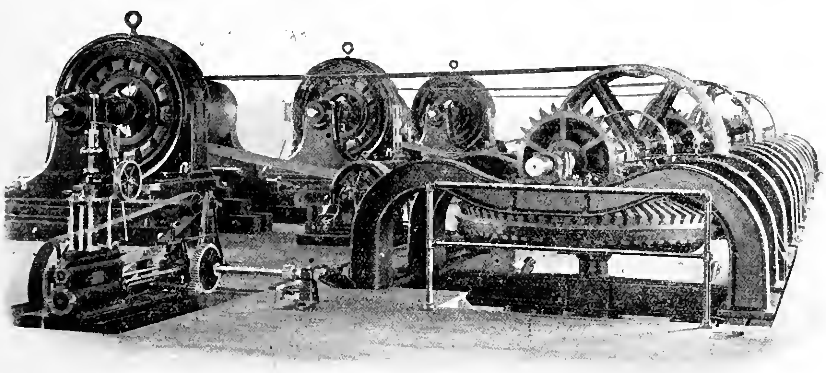
In prominent United States cities the people simply put their foot down and say they wont have night-shunting, the result being that the adoption of electric locomotives has decreased the noise in many places. Montreal with its three stations raises bedlam every night in summer; surely there is a field for some large electric firm to exploit the idea of electricity for yard work, with the chance of popular clamour behind them as an assistance.

Surely wiremen in Montreal can bring to bear sufficient influence on their employers to make a 9-hour working day for at least four months of the year, viz.: from December to March. It is simply unnecessary to have a man parading to his work cold and in the dark. As to private house work, most of them do not hold such early hours in winter in their establishments as in summer, and in unfinished buildings the extra hour is simply wasted and would be more than made up for by the fact of men working in the light and after more rest.

Old boys in the Royal Electric Company during the regime of Mr. Hagar, late general manager, who will remember the pair, Messrs. Seddal and Whyte, will be pleased to hear that they have drifted together again, and Mr. Seddal is now in the office of the Lachine Company assisting Mr. Whyte, their secretary. It would be a pleasant re-union if some of the old boys now scattered in Quebec, Charlottetown, St. John, N.B., Hamilton, etc, could have an hour's chat together and discuss old times. Although there was lots of hard work them, there was also a certain measure of fun and bon-homie which is regrettedly getting rarer.

It is on the tapis that a couple of lawsuits are in an embyro stage, being taken at the instance of certain fire insurance companies against certain electric lighting companies in this city. It is too early to comment on the case except to compare it to locking the stable door after the horse is stolen. Had the Underwriters an efficient and active inspector, on a suitable salary, and compelling inspection in each and every installation, such cases would probably never come up. Again, the fees universally collected would, even though small, nearly if not wholly recoup the salary paid. At present contractors groan under heavy fees, heavier than New York, for such voluntary inspections as may be requested by the customer.

The various companies, "Standard Light and Power," "Bell Telephone," etc., have been incensed by the proposal of one of our alderman that the "Royal Electric Company" be empowered to build a subterranean conduit to accommodate all wires; and acting under their rights secured by charter from the Legislature, have issued notice to the city separately that they will all lay conduits. Those in the trade here recognize two things, and these are: that, first, there is too much jealously in the business to allow of one company's conduit or any such deal being accomplished; and second, that none of the companies are particularly anxious to open streets at present. The lay press are trying to sensationalize the items, but the public at large are not much alarmed for their streets, at least at this stage of the game.



WESTINGHOUSE GENERATORS OPERATED BY McCORMICK TURBINES.

## INSTALLATION OF McCORMICK TURBINES.

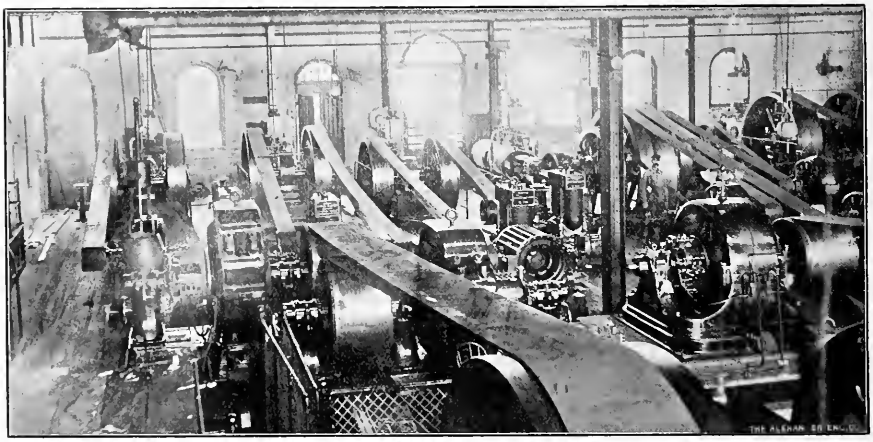
The accompanying illustration represents three belt-driven Westinghouse generators operated by four vertical shaft McCormick turbines, 72 inches in diameter, developing 3,600 horse-power under 19 feet head. This outfit was furnished to the Trade Dollar Mining Company, of Silver City, Idaho. The power is used for operating machinery in their mines. In addition to the water wheels, the S. Morgan Smith Company, of York, Pa., furnished all the machinery excepting the electr cal apparatus and the governor. The gates of all the turbines are operated by one Type B Lombard governor, working in connection with a lever gate hoisting device which makes it possible to dispense with all gears used in ordinary practice.

# ELECTRIC RAILWAY DEPARTMENT.

## THE ST. JOHN STREET RAILWAY.

As a means of rapid transit the horse car is now a thing of the past, but in this age of automiboes and motor cars it is still interesting to glance back and trace the evolution from the slow-going means of conveyance which our fore-fathers used to the modern up-to-date systems which are now to be found in all important cities and towns. In the city of St. John the progress made in this direction is perhaps more marked than that made in many of the other cities in Canada. The first street railway system which was operated in that flourishing city was established by the Peoples Street Railway Company in 1866. This, of course, was before the introduction of electricity into general use, and when the motive power was supplied by horses. Since then many radical changes have been made. In 1887 the St. John City Company acquired possession of the system, and for five years it was operated under their control. In 1892 it was recognized that facilities afforded by a system of horse cars was not sufficiently up-to-date for a progressive city, so the Consolidated Electric Company was formed to take over the railway and change the motive power to electricity, but it retained the flat rails and stringers previously in use. This company operated for two years, and in 1894 the St. John Railway Company acquired all the rights, powers, privileges, etc., of all the previous railway and lighting companies, also the St. John Gas Light Company, and consolidated the entire system under one management.

The old rails were replaced by seventy-four pound girder rails, the work being carried out by the late Frank P. Brothers, one of the best known railway men in Canada. Three years ago the present station was remodelled and enlarged. It is a brick building 150x100 feet, with steel truss roof, the iron work being supplied by the Dominion Bridge Company, of Montreal. In the boiler room there are two 2,000 h.p. Goubert feed water heaters, manufactured by the Goubert Mfg. Company, of New York, N.Y. These are used for heating the water before entering the boilers by exhaust steam. In the engine room there are several compound engines of the most improved type, one of them being an Ideal engine of 500 h.p., manufactured by the Harrisburg Engine Company, Harrisburg, Penn.; four McIntosh & Seymour engines, one 400, one 300 h.p. and two 150 h.p., manufactured by McIntosh & Seymour, Auburn, N,Y.; one Robb engine manufactured by the Robb Engineering Company, Amherst, N.S.; five Leonard engines, 150 h.p. each, manufactured by E. Leonard & Sons, London, Ont.; one Armington & Sims, 150 h.p., manufactured by Armington & Sims, Providence, Rhode Island. The two large engines furnish power for operating the street railway and the others are used for lighting and power. The large boilers consist of two batteries of 500 h.p. each, one-half battery at 250 h.p., making 1,250 h.p. in all. These boilers were manufactured by Babcock & Wilcox, Limited. A condensing system is used, consisting of air pumps, feed pumps and condensers. A circulating pump manufactured by the Northey Company, Toronto, is used for pumping sea water for condensing purposes.

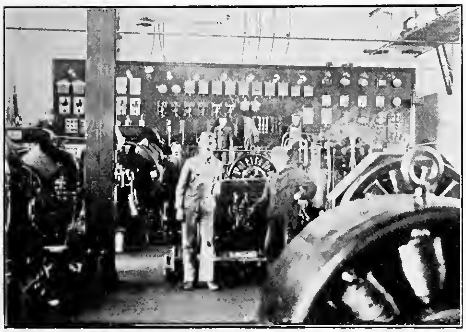


ST. JOHN STREET RAILWAY—INTERIOR VIEW OF POWER HOUSE.

In addition to the above the following electrical machines are in operation: Two 175 k.w. generators, manufactured by the Westinghouse Electric & Mfg. Co., Pittsburg, Pa.; two 200 k.w. generators, manufaetured by the Canadian General Electric Company, (these are used for street railway power); two 100 k.w. and four 45 k.w. Edison, three 1,000 light Slattery alternators manufactured by the Fort Wayne Electric Works, Fort Wayne, Indiana; one 120 k.w. alternator, manufactured by the Westinghouse Electric & Mfg. Company, Pittsburg, Pa.; one 120 k.w. alternator, manufactured by the Canadian General Electric Company; three 25, one 35, and four 50 light arc machines manufactured by the Royal Electric Company, Montreal; one 60 k.w. Brush arc machine manufactured by the Canadian General Electric Company (these being used for street and commercial lighting); four 60 light Wood arc machines, manufactured by the Fort Wayne Electric Company, Fort

Wayne, Ind.; one 90 k.w. 250 volt generator, manufactured by Messrs. Crocker & Wheeler, Newark, N.J.

The construction of the power house and installation of the plant was carried out under the direction of Mr. M. Neilson, general manager, and involved a cost of half a million dollars. To Mr. Neilson much credit is also due for the reorganization of the company and consolidation of the plant, and his able management is responsible for the present prosperous condition of the company. Thos. Irwin is chief engineer and H. A. Brown head electrician. Both these gentlemen have



St. John Street Railway—View of Switch-Board.

been in the employ of the company for a number of years and are thoroughly proficient in their different branches. The officers of the company are: President, James Ross, Montreal; vice-president, I. Morris Robinson, Montreal, Que.; sec.-treas. and general manager, M. Neilson, St, John, N.B.; directors, H. H. McLean, R. B. Emerson, James Manchester, J. J. Tucker, St. John, N.B.

## NEW METHOD OF CAR HEATING.

A unique method of heating street cars has been adopted in Christiania and Stockholm, Sweden. The apparatus consists of long, perforated boxes, one under each length of seats, one or both sets of apparatus being in operation as required. The boxes, which are shot in from the platform at either end of the car, are filled with red-hot coal briquettes specially prepared, so that no smoke or smell is emitted. A channel or iron sheeting runs underneath the seats, perforated on the outer side to allow the fumes or smoke to escape into the open air. On fresh air passing through a ventilator placed under the coal-box at the bottom of the car the hot combustible gases pass through this channel of iron sheeting throughout its entire length, diffusing a steady heat into the car through a set of perforated iron plates between the legs of the seats. It is found that the speed of the car causes sufficient draught, so that the briquettes are completely consumed. The temperature of 60 degrees C. is obtained even with an outside temperature of from 12 degrees C. to 14 degrees C. of frost. Last winter electric heaters were used on the electric line, but it is claimed the expense was too great, and this winter the Christiania Tramway Company, whose cars are horse-driven, and the new electric tramway both appear better sa isfied with the new method of heating their cars, as it is said a pleasant warmth is diffused without any trace of unpleasantness.

## THE MONTREAL STREET RAILWAY.

At the annual meeting of the Montreal Street Railway Company, held a few days ago, the statement presented showed a net profit for the year of $649,251.51, as compared with $646,246.64 for the previous year. Out of this amount four quarterly dividends of 2½ per cent. each were declar d, leaving a surplus of $97,551.51. The sum of $23,276.67 was expended during the year on special renewals. The operating expenses for the year showed an increase of 11.32 per cent. over the previous year, due to the increased cost of coal and increased expenditure required for the maintenance of the roadbed and rolling stock of the company.

Mr. Wanklyn, the general manager, stated that the company bought its hard coal at $3.73 per ton, which was an increase of 80 cents over the previous year, but was lower than any other company in Montreal paid. In fact one large company in Montreal paid $4.05. They had a contract with the Chambly Company for power at $25 per horse-power, but could not get more than one-quarter of the 5,000 contracted for owing to delay in delivering machinery. The best the company ever did for steam power was $32 per horse-power, but last year it ran up to $37 per horse-power. Coal at $2.25 per ton would be the equivalent of $25 per horse power, which was the contract with the Chambly Company. He hoped soon to have the whole of the 5,000 horse-power from the Chambly Company. There was also a large sum spent on new tracks. The explanation was considered satisfactory, and the report was adopted. Owing to the heavy increase in insurance the directors were authorized to set aside $100,000 as an insurance fund out of the surplus, and to continue each year to add thereto $10,000.

The company purchased and installed two steam units capable of developing 3,000 horse-power, the policy being to have duplicate plants capable of meeting all contingencies and to provide for the increase in the company's business. It was stated that in future a monthly statement of the company's operations, showing the gross and net earnings, would be published.

The number of passengers carried shows an increase annually. During the past year the number was 46,741,660, an increase of 3,379,398 over the previous year. The number of transfers granted last year was 14,217,784, showing that nearly every third passenger was given a transfer.

The Halifax Electric Tramway Company have secured a five years' contract from the city council of Halifax for street lighting.

The city engineer of Quebec is collecting information regarding municipal electric light plants, with a view to considering municipal control in that city.

The contract for street lighting in Charlottetown, P.E.I., has been given to the Charlottetown Light & Power Company, at $69.50 per lamp for a term of five years.

A committee of the town council of Goderich, Ont., have recommended the installation of the new style enclosed arc lamp and the adoption of the meter system.

The Government of Stockholm has ordered the Director of State Railways to prepare plans for converting the steam roads to electric traction, the power for which will be furnished by the numerous water falls of the country. A recent judgment of the Supreme Court decided that most of the water powers belong to the Crown, and not, as was commonly believed, to the Riparian owners.

# ENGINEERING and MECHANICS

## THE METRIC SYSTEM

By James Gill.

If I were to ask you the length of this room you would answer 40 feet, that is, you would use the unit one foot. You might also give your answer in yards. The unit in our system from which others were in the first place derived, is called the yard. That unit in any system which is taken as the standard is called the fundamental unit, and all others obtained from it by subdivision or multiplication are called derived units. Thus the yard is the fundamental unit in our system of linear measurement, and the foot and inch obtained by subdivision and rod, furlong, and mile obtained by multiplication are derived units.

The fundamental unit in the Metric System is the Metre, which is the one ten-millionth part of one-quarter of the Earth's circumference measured from the pole to the equator, and is equal to 39.37 inches, or $1\frac{1}{10}$ yards approximately.

The derived units are obtained by the use of prefixes from the Latin and Greek languages, viz.: deci, centi, milli, Deca, Hecto, and Kilo.

| | | | |
|---|---|---|---|
| decimetre (dm). | | $\frac{1}{10}$ | metre (m). |
| centimetre (cm). | | $\frac{1}{100}$ | " |
| millimetre (mm). | = | $\frac{1}{1000}$ | " |
| Decametre (Dm). | = | 10 | metres (ms). |
| Hectometre (Hm). | = | 100 | " |
| Kilometre (Km). | = | 1000 | " |

The prefixes deci, centi, milli, Deca, Hecto, Kilo, are used in all the tables of the Metric System.

The great advantage in all the Metric tables is that 10 units of one denomination make one unit of the higher; thus, in the table of linear measurement we have

| | | |
|---|---|---|
| 10 mms. | = | 1 cm. |
| 10 cms. | = | 1 dm. |
| 10 dms. | = | 1 m. |
| 10 ms. | = | 1 Dm. |
| 10 Dms. | = | 1 Hm. |
| 10 Hms. | = | 1 Km. |

Capital Dm. being used for Decametre to distinguish from decimetre (dm).

Instead of a student having to learn 12, 3, $5\frac{1}{2}$, 40 and 8, as in our table, 12 inches in one foot, 3 feet in one yard, he has only the number 10 to keep in mind.

Then passing to square measure, we have, since one centimetre = 10 millimetres

| | | |
|---|---|---|
| 100 square mms. | = | 1 sq. cm. |
| 100 sq. cms. | = | 1 sq. dm. |
| 100 sq. dms. | = | 1 sq. m. |
| 100 sq. ms. | = | 1 sq. Dm. |
| 100 sq. Dms. | = | 1 sq. Hm. |
| 100 sq. Hms. | = | 1 sq. Km. |

and so in the table of cubic measure the number will be 1000, instead of 100.

| | | |
|---|---|---|
| 1000 cubic mms. | = | 1 cubic cm. |
| 1000 c. cms. | = | 1 c. dm. |
| 1000 c. dms. | = | 1 cu. m. |
| 1000 cu. ms. | = | 1 c. Dm. |
| 1000 c. Dms. | = | 1 c. Hm. |
| 1000 c. Hms. | = | 1 c. Km. |

In our system we have an approximate relation in the statement that one cubic foot of water weighs $62\frac{1}{2}$ lbs., but in the Metric system nothing was left to chance, and the relation between volume and weight is given in the exact relation one cubic centimetre of water weighs one gram. Properly I should say the mass of one c. cm. of water is one gram. The gram (gm). is the unit of mass. Hence using our prefixes we have decigram, centrigram, milligram, Decagram, Hectogram, Kilogram.

| | | |
|---|---|---|
| 10 milligrams (mgms). | = | 1 centigram (cgm). |
| 10 cgms. | = | 1 decigram (dgm). |
| 10 dgms. | = | 1 gram (gm). |
| 10 gms. | = | 1 Decagram (Dgm). |
| 10 Dgms. | = | 1 Hectogram (Hgm). |
| 10 Hgms. | = | 1 Kilogram (Kgm). |

In passing to the measure of capacity we have as our first unit the litre (l), which is the volume of one cubic decimetre, or 1000 cubic centimetres; then as before we have decilitre, (dl), centilitre (cl), millilitre (ml), &c.

Since one litre = 1000 cubic centimetres, therefore the mass of one litre of water is 1000 grams = 1 Kilogram.

The following are some of the approximate values of Metric units in our units.

| | | | |
|---|---|---|---|
| Kilometre | = | $\frac{5}{8}$ | mile |
| Metre | = | $1\frac{1}{10}$ | yards |
| Centimetre | = | $\frac{2}{5}$ | inch |
| Kilogram | = | $2\frac{1}{5}$ | lbs. |
| Litre | = | 1.76 | pints |

As an example of the convenience of the system, let me work out a problem or two: 1. "How many millimetres are there in 5 Kms, 6 Hms, 7 ms, 3 cms, 8 mms? Since 10 of each denomination equals 1 of the next higher, we have 5,607,038 mms, putting a 0 where a denomination is left out, as between 6 and 7 where Decametre is left out and between 7 and 3 where decimetre is omitted. Changing from one denomination to another becomes a mere matter of shifting the decimal point. 5607038 mms = 5607.038 ms. = 5.607038 Kms.

2. A box is 5 ms. long, 3 dms. wide and 7 cms. deep. How many Kgms. of water will it hold?

| | | | |
|---|---|---|---|
| 5 ms. | = | 500 | cms. |
| 3 dms. | = | 30 | cms. |
| 7 cms. | = | 7 | cms. |

The box, therefore, has volume (500x30x7) cubic cms., which of water weighs (500x30x7) grams = 105,000 grams = 105 Kilograms.

*Paper read at October meeting, Hamilton No. 2, C.A.S.E.

## BOILER INSPECTION.

The following interesting extracts concerning boiler inspection are from the report of the Department of Public Works of the North-West Territories:

When the staff of the accountant's branch was increased during the year the departmental administration of the steam boilers ordinance, which is a revenue producing ordinance, was transferred to that branch from the correspondence branch, and the details of the administration are given below.

In the early part of the year the vacancy caused by the resignation of Mr. W. C. Wilson, one of the two inspectors appointed during the previous year, was filled by the appointment of Mr. W. M. Carment, of Kamsack, and in August the number of inspectors was increased to three by the appointment of Mr. William Waller, of Whitewood, this increase being necessitated by the fact that it was found impossible with two inspectors to reach all the boilers requiring inspection.

The work completed by the outside staff of inspectors, and in connection with the departmental administration of this ordinance, during the past year is summarized as follows:

| | |
|---|---|
| Number of steam boilers inspected | 509 |
| " " examinations of engineers held | 141 |
| " " first class engineer's cirtificates issued | 7 |
| " " second class engineer's certificates issued | 78 |
| " " third " " " " | 74 |
| " " provisional " " " | 178 |
| " " permits for operation of boilers issued | 42 |
| Fees collected: | |
| For inspection of boilers | \$2,430.00 |
| " Examination of engineers | 480.00 |
| " Provisional certificates. | 534.00 |
| " Permits for operation of boilers | 126.00 |
| | \$3,570 00 |

The number of boilers inspected during 1900 shows an increase of 129 over the number inspected in the preceding year, and the number of final, first, second and third class certificates to engineers also shows a marked increase. The number of provisional certificates, as was to be expected, decreased from 304 to 178, indicating that those who had been operating engines without special qualifications are rapidly dropping out, or by passing the necessary examination are becoming the holders of a final certificate in one of the grades mentioned.

The reports of the inspectors of steam boilers indicate that the large majority of the boilers in use in the Territories are in good condition, but it will be noted that they found several boilers being operated which inspection proved unfit for use, and there is no doubt that the issue of certificates condemning these boilers has averted incidents. The reports also indicate that a large number of the boilers in use require repairs, and one of the direct benefits to a boiler owner from inspection is that he receives a written statement from an expert as to what repairs his boiler requires to put it in safe working condition.

That it is desirable to have steam boilers inspected, and properly qualified men to operate them provided, is now, I think,

admitted by the large majority of boiler owners, but the disinclination to pay the fee for the inspection, particularly referred to by Mr. Carment in his report, is evident from many letters received during the year.

This is, however, only one of the many cases in which the common idea seems to be that if the Legislative Assembly decide that it is necessary to do anything they should also pay for the "doing." However, I am satisfied that ere long the persons most interested will realize that the small fee collected is only a fair charge for the return they get in having their boilers inspected and provision made for their operation at a safe working pressure.

The regulations adopted in 1899 regarding the lock pop safety valves on all boilers has provided the necessary check on the pressure used,but some difficulty has been experienced in getting all boiler owners to provide these valves, and when valves have been provided and properly set and locked some complaints have subsequently been filed regarding the pressure attained, clearly indicating what was previously suspected, that unless restrained by a locket valve from using a greater pressure than their certificate allowed, some owners had been in the habit of setting the old style valves to carry such pressure as they liked.

Four prosecutions for infringement of the steam boilers ordinance were enforced during the year, resulting in eash case in the imposition of the penalties imposed by the ordinance. It may, however, be stated that the large number of boiler owners have shown every disposition to comply with the provisions of the law, and it is, I think, generally recognized that the inspection of steam boilers is a necessary and a desirable work, considering the danger to life involved in their operation. I may, however, again direct attention to the fact that the lead of the Territories in this important matter is being followed in several of the older provinces, and that in Ontario this action is being taken upon the urgent solicitation of the engineers engaged in operating stationary engines and boilers. The experience gained in administering our ordinance during the past year indicates that some minor amendments are needed to make it work more smoothly, but with these amendments the present law certainly seems to provide for this important matter on a satisfactory basis.

## CANADIAN ASSOCIATION OF STATIOANRY ENGINEERS.

### TORONTO NO. 1.

The annual banquet of the above Association will be held at the Walker House on Thanksgiving Eve, November 27th. Tickets may be obtained from the members of the committee, Bros. W. J. Webb, H. E. Terry, A. M. Wickens, G. C. Mooring, James Bannan, N. V. Kuhlman, R. H. Johnston, and W. Clark.

Toronto No. 1 held its first meeting in Engineers' Hall, 61 Victoria street, on October 16th, President W.J. Webb presiding. William Bourne, superintendent of the Toronto Electric Light Company, gave a very interesting talk on Dynamos, Motors and their Troubles. He explained fully the different troubles that are liable to be met with in every day work, and told how to detect them and how to bridge over some of them temporarily. With the aid of the blackboard he fully explained the way to connect up different kinds of motors, which was very much appreciated by the members present. These open meetings will be held the third Wednesday of each month at 8 o'clock at the above hall during the winter months. All are welcome. The subject for the next meeting will be "The Necessity of a Lincense Law."

### HAMILTON NO. 2.

At the open meeting of Hamilton No. 2 held on October 10th, the chair was occupied by president F. J. Sculthorp. About 50 persons were present. A paper on "The Metric System of Weights andMeasures" was read by James Gill, B.A., of the Collegiate Institute staff. The paper, which appears in this Department, was interesting and instructive. Mr. Gill had a chart tacked to a blackboard, and by means of these he showed the system. On motion of Ald. Pettigrew a vote of thanks was tendered to the author of the paper.

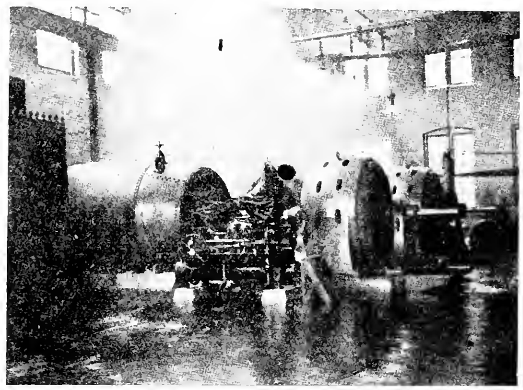
William Morris gave a very interesting talk on the machinery at the Pan-American Exposition, and the question drawer was opened and a number of questions answered by members of the Association. The meeting was a marked success and gave evidence of the benefits to be derived from the educational movement adopted by the Canadian Association of Stationary Engineers. Arrangements have been made for a series of open meetings during the winter.

## GOVERNING WATERWHEELS UNDER ABNORMAL CONDITIONS.

By G. U. G. Holman.

At the conclusion of some efficiency tests on our waterwheels at the power house of the Canadian Electric Light Company, Levis, Quebec, we desired to learn how the waterwheel governors operating the waterwheel gates would work upon breaking the machine circuit at full load of the generators. This meant the sudden removal of 1,000 horse-power. The result was startling, and for the moment appeared disastrous, for one side of the bonnet of the 30-inch gate valve in the main exciter pipe to the main pipe blew out. This valve was right at the connection of the exciter pipe to the main pipe flume, which is 8 ft. 3 inches in diameter. The head at this point of connection is about 97 ft.

The governors worked very nicely, perfectly controlling the McCormick turbines, the normal speed of which is 400 revolutions. The switchboard attendant had presence of mind sufficient to pull the exciter switch and kill the machine, for at the moment it looked as though everything would be deluged with water and spray. The accompanying photograph, which fortunately one of the gentlemen present was ready and able to take, shows how the water shot up into the roof of the power house. In many ways we were extremely fortunate, the break being just within the power house wall, the blown out side of the bonnet being about 8



Effect of Suddenly Releasing Wheel Under Full Generator Load.

inches from the power house wall. The impact of the water being upwards (the bonnet being vertical), the water fortunately maintaining a vertical stream, the generators, exciters and switchboard received no water and but little spray. There was a party of 15 gentlemen present, which naturally was an encouragement to the workman, several of whom ran immediately to the head gate and closed it after a few minutes. A short circuit at 78 gate had occurred but a few days previously, and was likely to occur at any time in the future, so that it was well that this weak point in our system developed itself at such an opportune time.

A temporary repair was effected by clamping the broken-out bonnet side partly in place by means of 2-inch oak planks placed at each side of the bonnet, with bolts run through them, round the edge of the bonnet. Of course, a great deal of water squirted through the bad joint, and this water was forced to drop into the tail race by keeping canvas over the valve. In this way we were able to run our exciters until 3 o'clock next morning, when the water was emptied, the broken bonnet taken off, the gate removed, and on the bonnet flange of the valve a 3-inch oak plank was bolted with a thick gasket. In this way the run was continued until noon, at which time a permanent repair was effected by replacing the plank with a ½-inch boiler plate, which a machine shop nine miles away made for us on record time.

We could discover no flaw in the bonnet of this valve, and the conclusion was forced upon us that it had not originally been built with a view to the service to which it was put. I might add that the governors are Lombard.

## SPARKS.

The citizens of Newcastle, N. B., are advocating the introduction of a system of street lighting.

The New Brunswick Telephone Company is planning to lay underground wires in the city of St. John, N.B.

An installation of electrical apparatus is to be installed in the new Sun Cement Works, Owen Sound, Ont.

An electric light plant will this winter be installed in the steamer Aletha, according to the Gananoque Reporter.

The Niagara, St. Catharines & Toronto Railway Company are building an addition to their power house at Merritton, Ont.

Beeton, Ont., last month carried a by-law to raise $7,000 for extending the electric light plant and for street improvements.

The promotors of the South Essex Electric Railway Company announce that a power house will be erected at Sandwich, Ont.

Surveyors are laying out a route for an electric railway between Toronto and Brockville, with a possible extension to Ottawa.

Mr. Van Dyke, of Grimsby, Ont., is said to be negotiating for the purchase of the Belleville Street Railway, his intention being to extend it to Trenton.

Ernest McAdoo, an electrician, fell from a scaffold while wiring the new building of the S. Carsley Company in Montreal, receiving serious injuries.

The town council of Almonte, Ont., have purchased a water power from Metcalf Bros., for $13,000, this power to be used for the operation of the municipal electric light plant.

It is probable that a by-law will be submitted to the ratepayers of St. Marys, Ont., at the municipal elections, to raise funds for the purpose of extending the street lighting system.

The Montreal Street Railway Company have agreed to provide a five minute day service for the municipality of St. Louis, the price of fares to be the same as now obtain in Montreal.

Tenders have been taken for central heating, power and electric plants for the Queen's University and the School of Mining buildings at Kingston, Ont. The architects are Symons & Rae, Toronto.

The award of the arbitrators in connection with the plant of the Kingston Light, Heat and Power Company is expected to be made this month, and the by-law submitted to the ratepayers in December.

The Von Echa Company have in contemplation the building of an electric railway from Brantford to Woodstock, Ont., and have arranged for running rights over the tracks of the Brantford Street Railway Company.

The city council of Winnipeg, Man., have written to the Department of Railways and Canals at Ottawa, asking upon what terms the Government will sell to the city all the electric power to be developed at the proposed St. Andrew's locks, on the Red River.

Mr. E. C. Hawkins has resigned as manager of the White Pass and Yukon Railway, and will remove from Vancouver to Dawson City. It is understood that he is promoting the building of an electric railway from Dawson to the principal surrounding mining districts.

Electric lighting propositions are still puzzling the city council of New Westminster, B.C. The British Columbia Electric Railway Company and the Stave Lake Power Company are the rival concerns, the works of the latter company at Coquitlam Lake being in an embryo state.

The proposition to replace the present arc lighting system in Brockville, Ont., with the new enclosed arc system, is still under consideration by the light commissioners. The dynamos now in use are somewhat dillapitated, and it is believed that the installation of a new plant would be found economical.

It is the intention of the Jacques Cartier Water Power Company, of Quebec, to immediately install a steam plant, to be used as an auxiliary to their present water power plant. Plans for the proposed power house have been prepared, and it is expected to have the installation completed early in the new year.

The Montreal Street Railway Company has instituted a series of bonusous to be distributed monthly among four motormen and four conductors, only those who have a clean sheet as regards accidents and general conduct being allowed to participate. The sum is to be $10 to each prize, and the men who have the best record will participate in the drawing.

When the Duke and Duchess of Cornwall were in Brantford, Ont., the Mayor introduced to them Prof. Bell, the father of the inventor of the telephone, who presented a casket containing a silver long distance telephone, suitably inscribed.

Buffalo capitalists are reported to have purchased the Peterborough & Ashburnham Electric Railway for the sum of $150,000. The road is six miles in length and was constructed as a model by the Canadian General Electric Company. The purchasers propose extending the line to Lakefield, a distance of seven miles.

A Halifax company have secured an option on the electric light plant at North Sydney, N.S. At a public meeting the ratepayers voted down a proposal to purchase the plant for $30,000, and it is probable that it will be disposed of to the Halifax company. The new company will make improvements to the plant and extend the transmission line to Sydney Mines.

The Toronto Electric Light Company have just commenced the erection of a new office building on Adelaide street east, to cost about $30,000, the plans for which have been prepared by Messrs. Gouinlock & Baker, architects. This is the first time that an architect has been employed by the company, the capable manager, Mr. J.J. Wright, having previously taken charge of such work.

The following names appear on a notice of application for letters patent to incorporate the Manitoba Water Power Electrical Co., namely: Henry Burkholder, of Chicago, financial agent; N. G. Leslie, of Winnipeg, bank manager: W. Georgeson, of Winnipeg, merchant; W. W. McMillan, of Winnipeg, grain dealer; I. M. Ross, of Winnipeg, contractor; H. Cooper, of Winnipeg, financial agent.

The Dominion Coal Company, of Sydney, N.S., has decided upon the use of electricity instead of steam on the Old Sydney and Reserve Railway. The power house will be located at Dominion No. 2. The system will be constructed on the same model as the suburban line of the New York, New Haven and Hartford railway through Massachusetts. It is expected that the road will be completed by July next.

Members of the Quebec Board of Trade last month visited Shawinigan Falls, Que., in a body to inspect the work now in progress at that place. Over $4,000,000 has already been expended, $2,000,000 by the Shawinigan Water & Power Company and the balance by the Pittsburg Reduction Company and the Belgo-Canadian Pulp Company. Calcium carbide works are in course of construction and will commence to manufacture next fall.

Gareau vs. Montreal Street Railway was a case in which the appellant sued the company for $15,000 damages caused to her buildings, which adjoin the company's power house on Barre street, Montreal, and were claimed to have been rendered untenable on account of the smoke from the boilers and the noise and vibration caused by the machinery. The action was dismissed in the trial court, and this decision was confirmed on appeal.

The Consumers Electric Company are making good progress with the construction of their power house at the Chaudiere, Ottawa. It will be 200 feet long and 40 feet wide. The plant will consist of two generators each of 2,000 horse power, and two exciters of 250 horse power each. The water wheel plant will consist of eight turbines of 500 h.p. each. They will be arranged in two units of four wheels each, each unit being attached to a 2,000 h.p. dynamo.

The annual meeting of the Montreal Park & Island Railway Company was held early in October. The report showed the gross revenue for the year ending August 31st to have been $128,677, and the working expenses $100,096, leaving a balance of $28,561. As the interest on the bonds was $61,500, there was an actual deficit of $31,918. The following board of directors were appointed: Hon. L. J. Forget, F. W. Henshaw, Kenneth Blackwell, James Ross, F. L. Wanklyn and W. G. Ross.

The town council of Port Arthur, Ont., have awarded the contracts for the Current river power developments. For building upper power dam the contract has been given to McFarlane & Company, at $11,000. The Jenckes Machine Company, of Sherbrooke, Que., will supply the penstock and turbines, and the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, the generators and electrical apparatus. It is said that there was a wide difference between the various tenders submitted.